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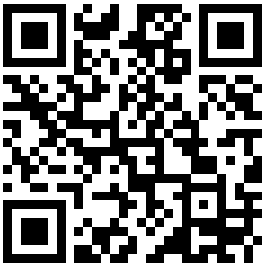

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METHODS AND PROBLEMS OF MEDICAL EDUCATION

(THIRD SERIES)

DIVISION OF MEDICAL EDUCATION
THE ROCKEFELLER FOUNDATION
61 Broadway, New York, N. Y., U. S. A.
1925

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PREFATORY NOTE TO FIRST SERIES

In the present period of unprecedented progress and readjustment in medicine, the problem of the dissemination of information is becoming increasingly difficult and perplexing. In the field of research, productive effort is so abundant that it is quite impossible for an investigator to keep in touch with general literature except through abstracts or reviews. Moreover, lengthy papers, and especially those dealing with problems of administration, equipment, methods, and maintenance of laboratories and clinics, are year by year more difficult of publication. This is especially true of contributions in the field of medical education, which, in that they are fundamental to all progress, are in the long run of prime importance. Plans of new buildings, methods of instruction, and experiments in teaching are usually published in local journals or for distribution as commemorative volumes in connection with a dedication or inauguration of new facilities. Such material, naturally, is not widely disseminated. Likewise, the traveler to other countries, interested though he may be in fundamental problems of medical education and returning with first-hand information of new buildings and new methods, can reach only a few associates or perhaps the staff of a single institution.

To avoid some of these difficulties, it has seemed advisable to the officers of the Division of Medical Education of the Rockefeller Foundation to collect and publish from time to time brief descriptions of clinics, laboratories, and methods of teaching in different parts of the world in order that the information in convenient form may be brought to the attention of those most interested. It is hoped that the material may be of assistance to those planning improvements in buildings and methods.

The collection of articles here presented constitutes the initial effort in this venture. Other collections will appear from time to time. The recipients of these volumes are invited and urged to make suggestions concerning other material which might be published to advantage in the same form, to comment concerning improvements, and also to offer the names of those who might be interested either in these collections as a whole or in the "separates" representing special fields. These articles are not copyrighted and permission to reprint or utilize in other ways is not necessary.

RICHARD M. PEARCE, *Director*
Division of Medical Education
The Rockefeller Foundation

New York
September 10, 1924

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UNIVERSITY OF CAMBRIDGE DEPARTMENT OF PHYSIOLOGY

BY

J. N. LANGLEY, SC.D., F. R. S.

PROFESSOR OF PHYSIOLOGY

HISTORICAL

The first experimental laboratory known to have been equipped in Cambridge was the fifteenth century Audit Chamber of King's Hall, which Richard Bentley, the Master of Trinity, converted soon after 1702 into what he called an "elegant Chymical laboratory" for Francis Vigani, the first University Professor of Chemistry. This room, now the Bursary of Trinity College, may also be regarded as the first physiological laboratory, for it is known that Stephen Hales, fellow of Corpus Christi College, who first measured the blood-pressure and made many important observations in animal and plant physiology began his experiments early in the eighteenth century in this "elaboratory of Trinity College."

But though many graduates in the ancient Faculty of Medicine in the University have left names now illustrious in the history of physi-

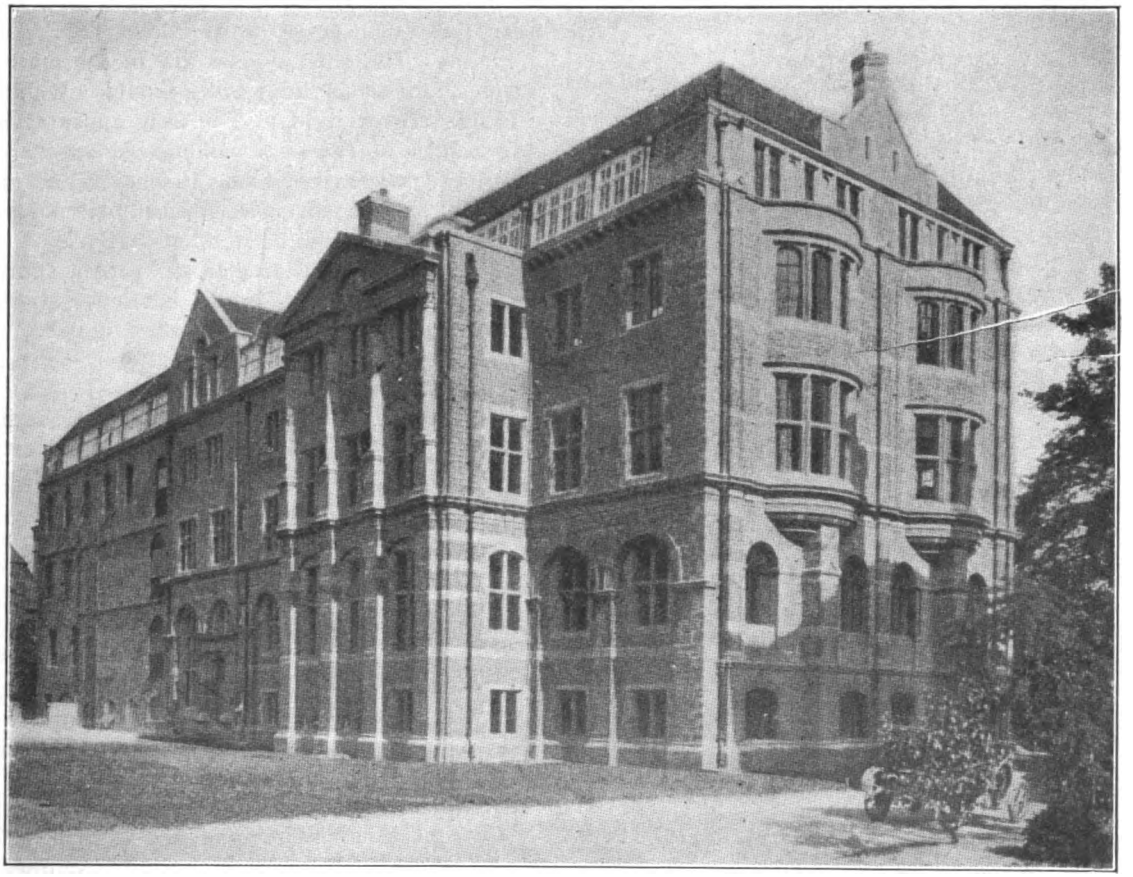

FIG. 1.—VIEW OF BUILDING FROM THE NORTHWEST

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ology, like those of Harvey and Glisson, and in a less degree those of Wharton, Joyliffe, Jurin, Wollaston, and Young, their chief work was not done in Cambridge itself, and it was not until the last third of the nineteenth century that physiology began to be regarded no longer as an appanage of human anatomy or of zoology, but as an independent experimental science in the main line of biological enquiry, and as an essential part of medical study.

With the hope of establishing the study in Cambridge, Trinity College in 1870 brought Michael Foster from London, where he had shown high promise as a physiologist, and elected him to a fellowship and praelectorship in physiology. Two rooms were granted to him by the University as his sole laboratory for experimental and chemical physiology. The rooms were furnished and equipped by Trinity College and it may be said that from this beginning, under the inspiration of Foster and his pupils, there have arisen in due succession all the laboratories now connected with biological studies in Cambridge. In 1883 a professorship of physiology was founded in the University and Foster was elected to the new chair, which he occupied till 1903.

From Foster's time development was rapid, but the provision of rooms for practical instruction lagged far behind the increase in the number of students. In 1910 a promise of relief from the congestion came from the Worshipful Company of Drapers, who generously offered to erect a new physiological laboratory. Sir Thomas Jackson, R.A., was appointed architect, and the details of the building were arranged in consultation with Professor Langley and a committee appointed by the University. The building was presented to the University in 1914. It was connected on one side with the Department of Psychology, and on the other side arrangements were made for the subsequent erection of a large lecture theatre and for the extension of the main building.

In accordance with the common-sense English custom, physiology when separated from human anatomy carried with it physiological chemistry and vertebrate histology, both of these having more relation to function than to morphology. With regard to histology, the physiologist has constantly to refer back to cellular structure in order to explain experimental results, and many of the more important histological results are, in fact, to be found in papers written by physiologists. All the divisions of biology are more or less artificial. When any line of study has accumulated a sufficiently large number of facts, it becomes a whole-time job and is ripe to become a separate department. Thus when the new building for physiology was erected, physiological chemistry was separated from physiology and became the Biochemical Department. Vertebrate histology was, however, retained as part of physiology, where it is best taught until it buds out into a separate department and includes the histology of invertebrates.

DESCRIPTION OF BUILDING

The building consists of five stories, the lowest being sunk five feet below ground level. The floors are of fireproof construction throughout and the roof trusses are of iron, which is exposed as much as possible within the building. At the west end, the fourth and fifth stories are thrown together into one large room for histology classes, and here the fifth story is represented by the gallery (see Fig. 5) which surrounds the room. The special necessities for light in this room made the architectural treatment of the roof difficult. The ridge and furrow roof bears skylights on its western slopes and these are transverse to the long axis of the building. The chief classes are in the morning, when no direct sunlight gives trouble by shining through the skylights. The ugly appearance of the ridges in saw-edge silhouetted against the sky has been masked along the north and south external sides by narrow longitudinal roofs, and these are tiled.

Externally the building is of Cranley (purple) and Bracknell (red) brick, with dressings of Clipsham stone.

Ground Floor

In addition to the rooms occupied by the heating apparatus, the destructor for animal refuse, and the stores, the ground floor includes the following:

The battery and switchboard rooms. The main electric supply to the laboratory is the direct current at a pressure of 100 volts derived from a 480 ampere-hour storage battery of fifty-five cells. These are charged several times a week by means of power transmitted as alternating current from the engineering laboratory, a rotary transformer being provided in the switchboard room for the production of the direct current which is led into the cells.

Current at a pressure of six volts is led off from three of the cells of the battery, different cells being in use for this purpose each week in

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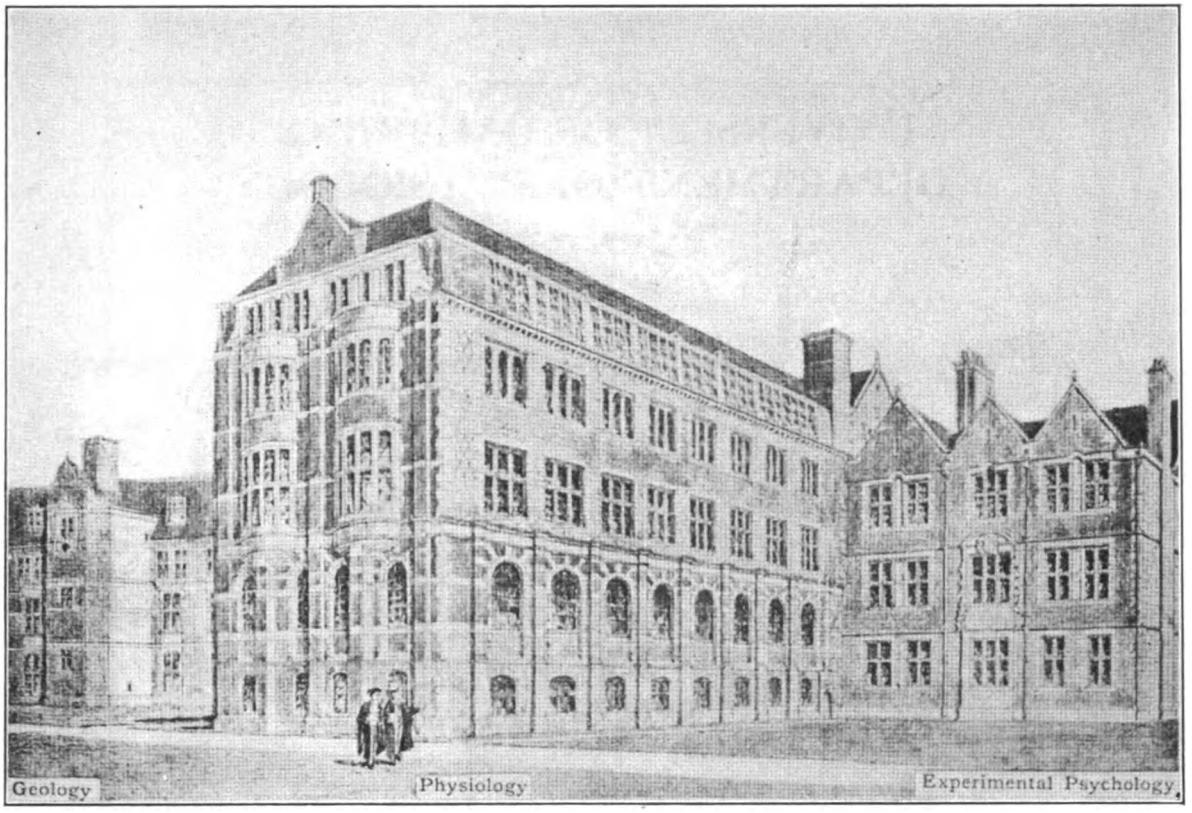

FIG. 2.—VIEW OF BUILDING FROM THE SOUTHWEST

order to ensure similar treatment for them all in turn. This weak current is used to drive time-marking clocks, tuning forks, and similar apparatus. Current at both pressures, 100 volts and six volts, is available in each research room not only from wall plugs but also from lamp-holders hanging from the ceiling. To most of the rooms there is distributed also a special circuit capable of carrying a current of 20 to 30 amperes at the higher voltage.

In addition, the electric supply from the town mains (200 volts alternating, with a periodicity of 90 per second) is laid on to certain rooms in which heavier motors are liable to be run continuously.

Compressed-air plant. The air compressor is driven by an electric motor from the direct-current supply. The system of pipes distributed through the building and the air-reservoir connected to the compressor have sufficient capacity to prevent rapid variations of the pressure. In order, however, that the supply may always be available at 25 lbs. per square inch the system is fitted with an automatic switch which starts the compressor as soon as the pressure drops to a predetermined value.

The compressed-air pipes are distributed to the research rooms throughout the building. The chief purposes of the supply are the artificial respiration of animals, the pumping of fluids which must not be brought into contact with metal pumps, and the drying of the inside surfaces of glass apparatus.

Centrifuges. In the same room as the air compressor are two electrically driven centrifuges. The larger has a total capacity of 600 c.c. and attains a speed of 4,000 r.p.m., while the smaller runs at a slower speed and carries about 100 c.c. of material.

The refrigerating plant occupies the adjoining room. By the sudden expansion of compressed carbon dioxide it can maintain continuously at a temperature of 0° C. a heat-insulated cold-storage chamber situated immediately above, on the first floor. There is also a large brine tank which can be cooled to a temperature of —10° C. for special purposes.

The workshop. This is intended only for the making of small pieces of apparatus and for the running repairs of the laboratory. It is equipped with two screw-cutting lathes of 3½-inch centres, a sensitive drilling machine, emery grind-

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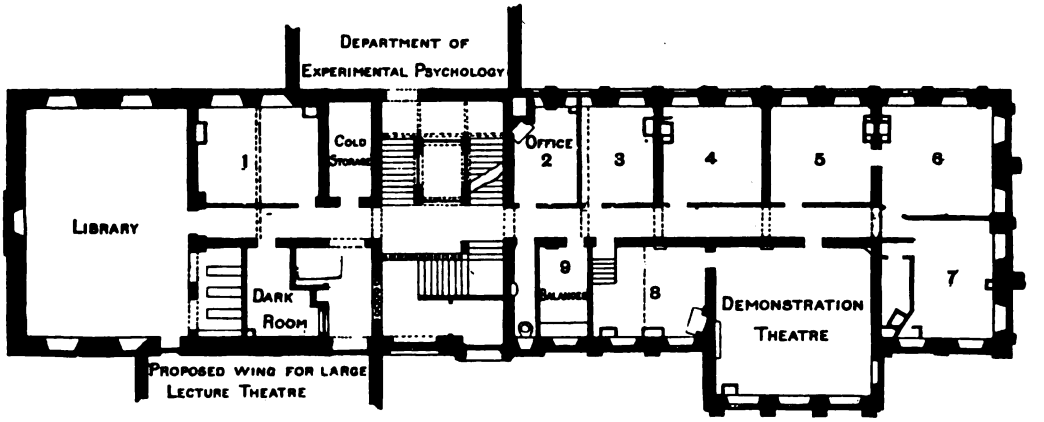
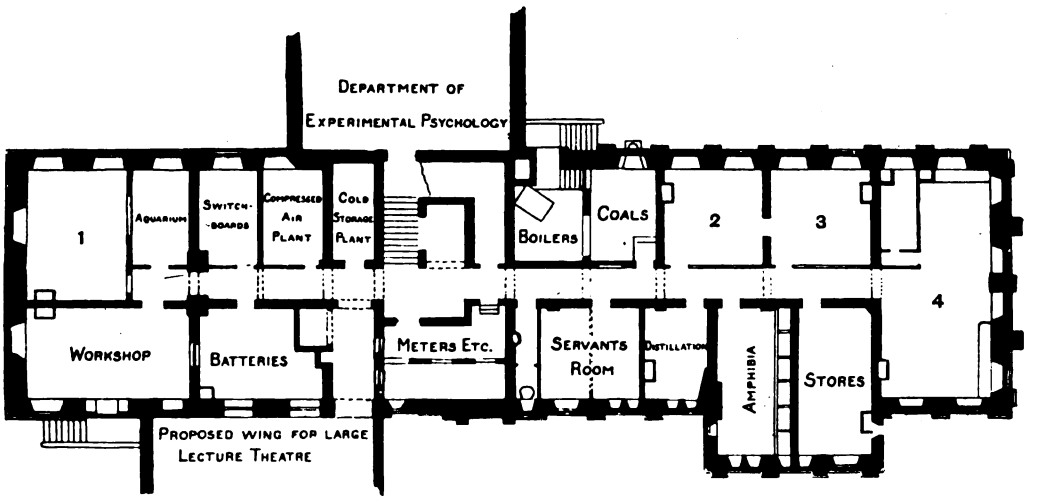


FIRST FLOOR



GROUND FLOOR

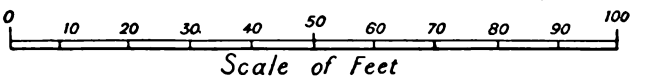


FIG. 3

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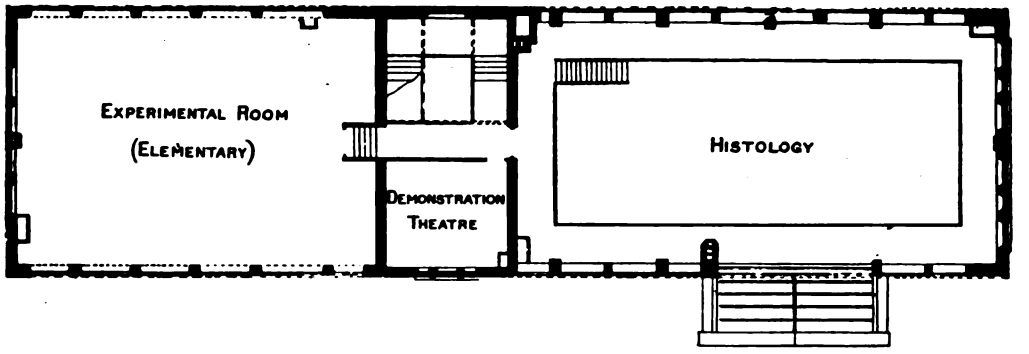

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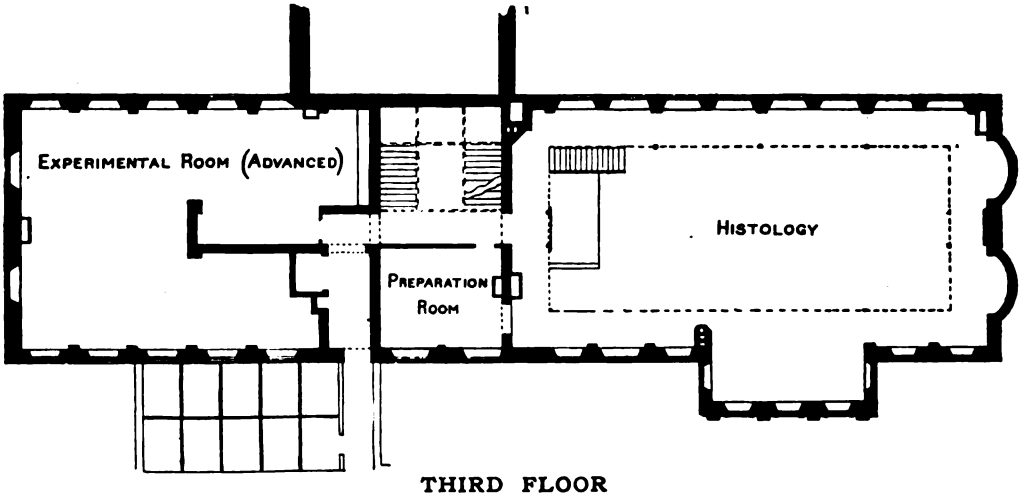

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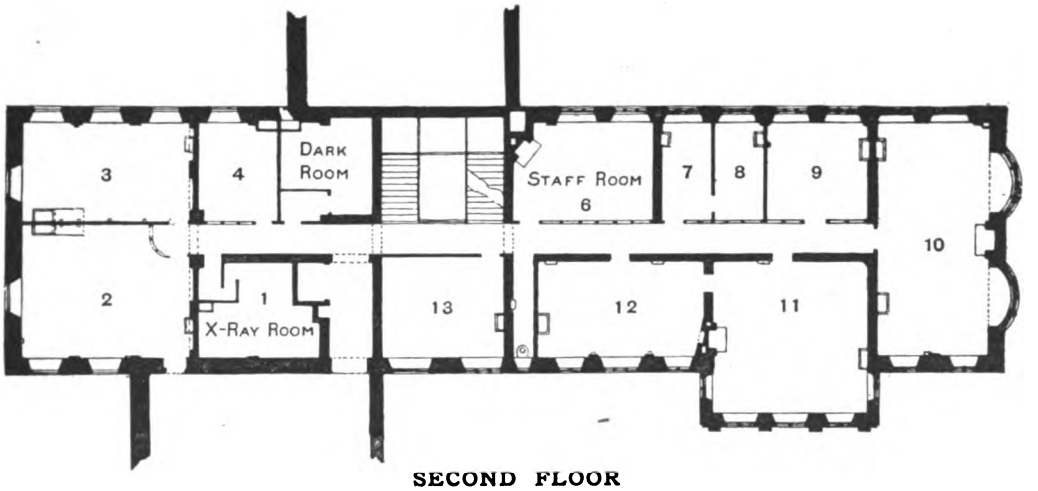

SECOND FLOOR

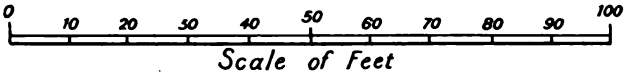

FIG. 4

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ers, and grindstone. All these are driven through overhead shafting by a 3½-h.p. electric motor. A small hand-shaping machine is also provided.

The aquaria. One room is set apart as an aquarium for marine animals. It is provided with stoneware tanks of sea water which is aerated by a system devised by Keith Lucas in which a current of air bubbles through a tall column of sea water and carries it over slowly into the main tanks in the form of froth; by means of an overflow syphon the water in the tank returns automatically at the same rate to the aerating vessel. The necessary current of air is forced through the apparatus by means of a jet of water from an ordinary supply tap. The method has proved capable of maintaining the animals in good condition without renewal of the sea water more often than once in three months. The water is obtained from Lowestoft, and is filtered through Berkefeld filters before it is used in the tanks.

Another room is fitted with large tanks supplied with running water for the storage of the large numbers of frogs required for experimental classwork.

Research room for electrophysiology. The principal room is numbered 4 on the ground plan. It has been designed for research into the electric stimulation of nerves and muscles and into the electric phenomena which accompany their action. For the latter purpose a string galvanometer and a capillary electrometer are installed on anti-vibration supports and are so arranged that their movements can be recorded by photography in the adjoining dark room. On stone slabs let into the walls of the room there are placed the various devices used for measuring and timing electric stimuli. There is a pendulum capable of delivering two or three electric shocks at determined intervals of time ranging from one ten-thousandth to one-tenth of a second; a machine is also provided which will deliver a longer succession of shocks, the strength, duration, and periodicity of which can each be controlled independently.

This room has been placed in the basement, and at the greatest possible distance from the

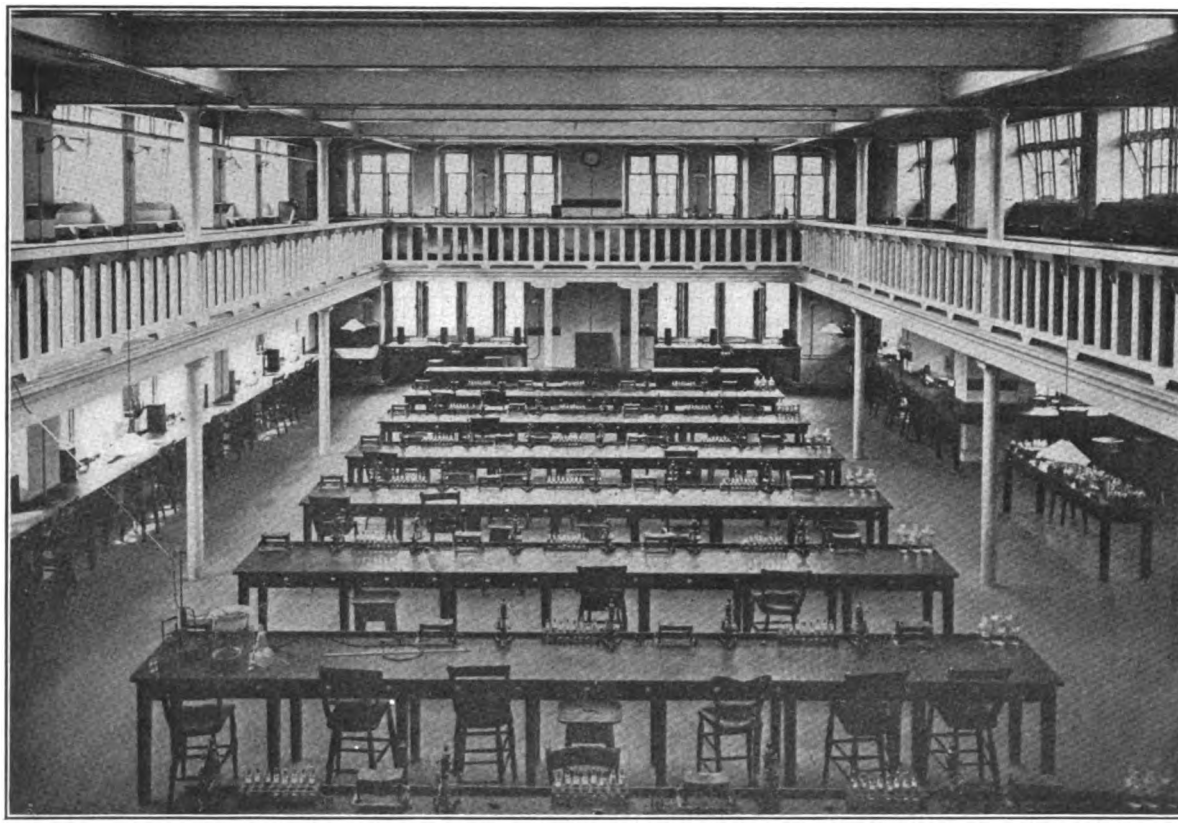

FIG. 5.—ELEMENTARY HISTOLOGY ROOM

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rooms which contain running machinery, in order that the capillary electrometer may not be affected by vibration.

Thermo-electric research is carried on in the intercommunicating rooms Nos. 2 and 3. Temperature changes of as little as a millionth of a degree Centigrade in a muscle are measured by means of delicate thermopiles combined with a galvanometer of extreme sensitiveness heavily screened from external magnetic fields. By mathematical analysis of the records obtained with this apparatus, Hill and Hartree have been able to estimate the various quantities of heat liberated during the several phases of a muscle twitch.

Research room No. 1 is large and capable of accommodating a couple of workers. It is provided with a dark room suitable for use with a string galvanometer or for other photographic recording. A restroom for the laboratory servants is also provided on this floor.

First Floor

The chief rooms on this floor are:

The demonstration theatre, which is entered from the first floor, but extends somewhat below its level into the basement. It will accommodate a class of about eighty. Experiments can be prepared in the adjoining lecturers' room (No. 8) before being brought into the theatre for demonstration. For lantern demonstrations a large projecting apparatus is provided, and during its use the room can be darkened by blinds which are operated electrically from the lecturer's table. Cinematograph pictures may be projected on the screen through an aperture in the back wall of the theatre from a projector in the next room. In this latter room is placed also the photo-micrographic apparatus.

A small lecture room (No. 1) capable of seating about twenty and provided with a projection apparatus for microscopic preparations. This room is used for the relatively small classes of advanced students.

The library. Here an effort is made to provide a good selection of the more important English and foreign physiological journals rather than of standard textbooks, which are more generally available in college libraries.

The research rooms on this floor are four in number. Those numbered 5 and 6 in the plan constitute a pair of intercommunicating rooms fitted with sterilisers and other equipment for operations requiring aseptic precautions. No. 4 contains a kymograph for mammalian experiments, while in No. 3 is assembled the somewhat complicated apparatus required for the electrometric measurement of the reaction of body fluids.

The remainder of the space on this floor is occupied by the balance room, the cold-storage chamber, a dark room, and the laboratory office.

Second Floor

With the exception of a *common room* (No. 6) for the teaching staff, the whole of the accommodation of this floor is devoted to research purposes.

The professor's private laboratory (No. 10) at the west end of the building is provided with equipment for experimental and histological research as well as for the administrative work of the laboratory.

The three rooms Nos. 7, 8, and 9 have been designed and equipped, under the direction of Mr. Barcroft, for the study of the respiratory function of the blood. They contain mercury vacuum pumps and other apparatus for the estimation of the blood gases, and also apparatus for the exposure of samples of blood to gas mixtures of known composition. There is also equipment for spectrographic work on respiratory pigments.

Investigations on the respiration of the whole organism are provided for in room No. 12 in which a large airtight chamber of plate glass has been erected. Suitable air-purifying apparatus is attached, together with air-locks for the passage of food, etc., and a stationary bicycle for purposes of muscular exercise so that as many as three subjects may remain in the chamber under various conditions of oxygen tension, temperature, muscular activity, and so on, continuously for as long as a week at a time.

Optical research is carried on in room No. 4 with its adjoining dark room.

X-ray room (No. 1) is equipped for the special needs of physiological investigations. Tables convenient for the exposure of the usual experimental animals are provided, and a vertical sliding tube-holder for demonstrations on man is installed.

The chemical room (No. 2) is fitted with fume cupboards, and is adapted for manipulations of a more purely chemical nature.

The remaining rooms on this floor, Nos. 3, 11, and 13, are available for general research purposes.

Third and Fourth Floors

The laboratories for the teaching of practical histology and experimental physiology are situ-

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ated at the top of the building on the third and fourth floors.

Elementary classes in histology occupy the histological laboratory—a large room on the third floor, with galleries at the fourth floor level. Abundant light is provided for the microscopes not only from the sides but also from the roof lights. Electric lamps are provided on the benches for use in dull weather. Microscopic sections and other materials are prepared in the adjoining room. In this laboratory with its galleries 150 students can work simultaneously.

The elementary experimental laboratory is situated on the fourth floor. It provides recording drums and electrical stimulating apparatus for sixty-two pairs of students.

The drums are arranged on five tables, which form separate units and can be worked independently. The driving mechanism is of a particularly simple kind and has been specially designed for this laboratory. Along the edge of each table there runs a continuous line of steel shafting driven by an electric motor which stands on the floor. Each drum is driven from the shafting through a pulley and a cord kept taut by a weight hanging beneath the table. The drums which are at present in use are of three types. Sixteen of them formed the equipment of the old physiological laboratory (some of these have been in use since 1884). Of the remainder, thirty are of a type designed by Keith Lucas for the present laboratory and can be driven at six different speeds ranging from one revolution per second to one revolution in thirty-five minutes. In the case of these instruments, a lever placed conveniently near to the drum serves for clutching the driving pulley to the shafting and so for starting the drum. The special feature of this system is that no part of the mechanism with the exception of the main shaft is put into motion until the drum is actually required to rotate, so that wear of the moving parts is reduced to a minimum.

The remaining drums, sixteen in number, are of the Sherrington model. Each student is provided with a small storage cell as a source of current for the stimulation of nerves and muscles. The cells are charged from the main battery in the laboratory at a time when there is no class occupying the room, and the students draw their current from special terminals on the cells which are provided with a safety resistance to prevent too heavy a discharge being taken.

On the same level as the experimental room a small demonstration theatre is placed centrally and here classes of any number up to fifty can be drafted successively from the larger rooms to see demonstrations of methods or experiments.

For the comparatively small classes of advanced students practical work is conducted in the advanced classroom on the third floor.

The tables under the windows are set apart for microscopical work for which also a paraffin embedding oven is provided. The center of the room is occupied by tables equipped for experimental work. In addition to recording drums and apparatus for electrical stimulation, there are six electrically warmed operating tables for the study of mammalian physiology in the decerebrate or decapitate preparation. Each of these is provided with a supply of air for artificial respiration from one of two simple respiration pumps constructed from disused motor-bicycle cylinders, and driven by the motors which operate the drums. Each table has also an electro-magnetic time marker activated by a central signal clock.

On a massive stone slab a string galvanometer with photographic recording apparatus is kept permanently available for the use of advanced students.

The animal house is a small building separate from the rest of the laboratory. The rooms are arranged on one side, have top ventilation, and are heated by hot-water pipes from a boiler. In front at one end is a glass house with sunken and raised tanks for amphibia. The rest of the space in front is covered in with wire netting. One room not communicating with the rest is for keeping newly received animals in quarantine. The other three communicate, and are arranged with cages for small animals and with runs for such rabbits and cats as need not be kept separate. Two of the runs for cats open into yards outside.

One addition to the laboratory has been made since the war. There are a number of experiments which require special apparatus which cannot be provided for each student. A large army hut was acquired in which such apparatus could be set up on separate tables and remain unmoved for the term. The students pass in rotation from one set of apparatus to the next, till all the experiments have been made.

TEACHING PROGRAM

Teaching in the physiological and biochemical departments is carried on as far as possible concurrently. The elementary course, taken by most of the students in their first year, and the intermediate course, taken by most students in

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their second year, consist of instruction in experimental physiology, histology, and physiological chemistry, the major part of the histology (except advanced practical work) is, however, given in the elementary course. Pharmacology has a department to itself, and instruction in this is chiefly given in the summer long vacation.

The number of students (including women) attending the several courses in 1922-1923 were:

	Michaelmas Term 1922	Lent Term 1923	Easter Term 1923
Elementary	141	159	224
Intermediate	208	187	115
Revision	84	...	180

The total attendance at the advanced classes in the three terms varied from eleven to forty-one, and the total attendance at the classes in the long vacation was 259.

The normal course of study in physiology of a student reading for honours in natural science or for a medical degree is as follows: Students begin their study of physiology in their first or second year of residence, according to the extent of their previous preparation in chemistry, physics, and biology. The majority of medical students have some training in these subjects before entering the University and commonly have qualified in them so far as is required by the first M.B. examination.

We may take the course of a student who takes physiology in his first year. He attends the elementary course of lectures covering the physiology and histology of blood, the connective tissues, nerve, muscle, the vascular system, respiration, the digestive excretory systems, the special sense organs, reproduction, and an elementary course of physiological chemistry in the Biochemical Department. The central nervous system and the endocrine organs are treated in a purely introductory manner.

The student usually resides for about six weeks in the summer vacation, when courses are given which vary somewhat from time to time. At present there is a course of lectures, with practical work on respiration, and a series of demonstrations on anaesthetised, decerebrate, or decapitate animals. Each is a three-week course. In the other three weeks, biochemical courses are given. Opportunity is afforded of doing selected experiments, the apparatus for which is set out in the army hut (cf. p. 14), but

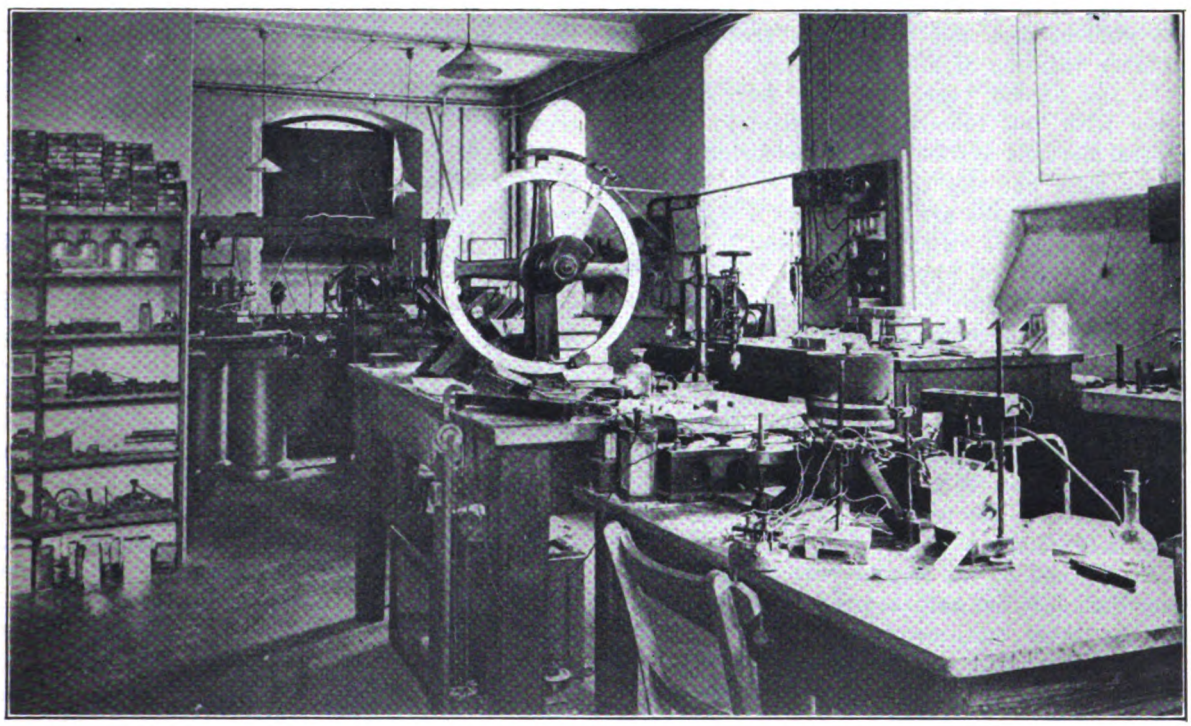

FIG. 6.—RESEARCH ROOM FOR ELECTROPHYSIOLOGY. APPARATUS FOR TAKING RECORDS OF ELECTRIC CURRENTS IN TISSUES BY (A) CAPILLARY ELECTROMETER AND (B) STRING GALVANOMETER. THE DARK ROOM IS ON THE LEFT BEHIND THE SHELVES

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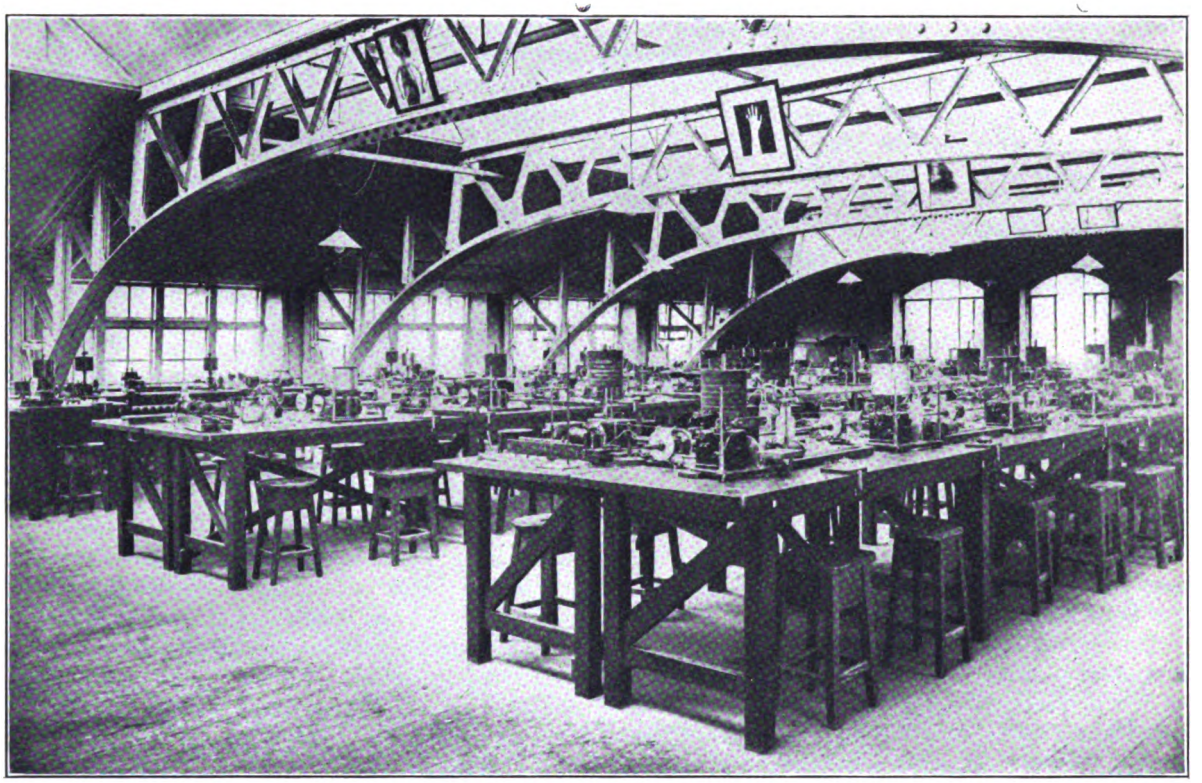

FIG. 7.—ELEMENTARY EXPERIMENTAL LABORATORY

the student does not usually do these till the summer vacation of his second year.

In the second year, the first term's course deals with the function and histology of the central nervous system of the endocrine glands, which were but slightly touched on in the first year. The lectures are three times a week. The practical work is twice a week, and it includes some experimental physiology and histology. In the second and third terms there are lectures on physiology of a somewhat more advanced character. The practical work in the second term includes working through in rotation some twenty experiments, which require special apparatus. The courses in all three terms are arranged to fit in with those of the Biochemical Department. The practical courses vary from four to six hours a week.

At the end of the second year some students pass Part I of the natural sciences tripos, taking two or three subjects besides physiology and biochemistry: but the majority defer this till the end of the third year. In the first term of the third year most take a revision course in physiology and biochemistry, and pass the second M.B. examination in physiology (and anatomy). In the other terms, they may reattend the second-year courses, a certain number taking one or more of the advanced courses, and revise their subjects for Part I of the natural sciences tripos.

The student who has passed Part I of the natural sciences tripos, if he wishes to learn more of physiology passes on to Part II of the tripos. In this one subject only is allowed, and the student's whole time is given to the advanced course and to reading. As a rule each advanced course is given by a lecturer who has carried on research in the subject. Of the practical courses, there need only be mentioned one on mammalian physiology, on the lines laid down in Sherrington's "Practical Exercises in Mammalian Physiology."

Hitherto "Physiology" in Part II of the natural sciences tripos has included biochemistry. It is proposed that in future there should be separate subjects, so that a candidate's time after taking Part I can be devoted entirely to one or other of these subjects.

RESEARCH

The research carried on varies from time to time. The general lines of research now being followed are:

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The arrangement and functions of the autonomic nervous system, including the effects of typical drugs.

The properties of haemoglobin, oxygen-transport, and oxygen-use in the body. The influence of variations of atmospheric pressure.

The hydrogen-ion concentration of body fluids and the transport of carbon dioxide.

The regulation of respiration.

The electrical phenomena of nerve and muscle. The relation of the "all or nothing" law to nervous impulses, passing to the central nervous system.

The phenomena of nerve and muscle degeneration and regeneration.

The heat formation in muscular contraction.

The theory of auditory and visual sensations.

The velocity of chemical combination, especially in relation to haemoglobin.

STAFF

Professor of Physiology: J. N. Langley, Sc.D., F.R.S.

Reader in Physiology: Joseph Barcroft, M.A., F.R.S.

University Lecturers

General physiology: L. E. Shore, M.D.; W. B. Hardy, M.A., Sec. R.S.; E. D. Adrian, M.D., F.R.S.

Special senses: H. Hartridge, M.D., Sc.D.

Senior demonstrator: H. Hartridge, M.D., Sc.D.

Junior demonstrator: Ff. Roberts, M.D.

Additional demonstrator: T. R. Parsons, B.Sc., M.A.

In connection with the Department, lectures are also given by Dr. F. H. A. Marshall, F.R.S., and by Mr. J. Gray, M.A., demonstrators for the practical courses as required are appointed by the professor from recently graduated students. No member of the staff is engaged in medical practice.

Departmental Servants

All the laboratory assistants are expected to do any work required in the laboratory and to help those carrying on research. Apart from this, their duties are more or less specialised:

Assistant in the office especially concerned with helping in animal experiments in research and demonstration, and in reporting any divergence from the normal working in the laboratory.

Assistant in charge of the histology rooms, is responsible for preparing or seeing prepared, histological specimens, and has general supervision over the research apparatus.

Clerk whose chief work is recording the attendance of students and of correspondence.

Assistant in charge of the experimental room for elementary students.

Man in charge of the animal house.

Three women assistants who help in the histology and experimental classrooms.

Boy for errands and to be trained for promotion.

In addition a charwoman is employed for two hours each morning in dusting and cleaning. Additional charwomen are engaged for cleaning the floors. Building repairs and window cleaning are arranged for by the University.

FINANCE

The financial arrangements of the laboratory are in a period of transition. Formerly most of the lecturers were college lecturers and their stipends were paid mainly by the colleges and did not appear in the laboratory accounts. This is to be modified in future in accordance with the recommendations of the University Commission. Thus it is impossible to say what the total payments to the staff were in the past or will be in the future. Apart from such payments, the annual expenditure on upkeep (including research) is rather less than £2,000, and that on wages of assistants rather more than £1,000.

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THE LABORATORIES OF PHYSIOLOGY
OF THE
HARVARD MEDICAL SCHOOL

BY

ALFRED C. REDFIELD, PH.D.
ASSISTANT PROFESSOR OF PHYSIOLOGY

INTRODUCTORY

Physiology at Harvard is represented by four departments, which are all housed under one roof and are bound together by a loose organization known as the "Laboratories of Physiology." While the constituent departments are perfectly distinct and autonomous in matters of administration, personnel, and budget, this organization enables them to function as a unit in teaching, the exchange of equipment, and the like, and really constitutes an institute of physiology superior in its scope to any individual department.

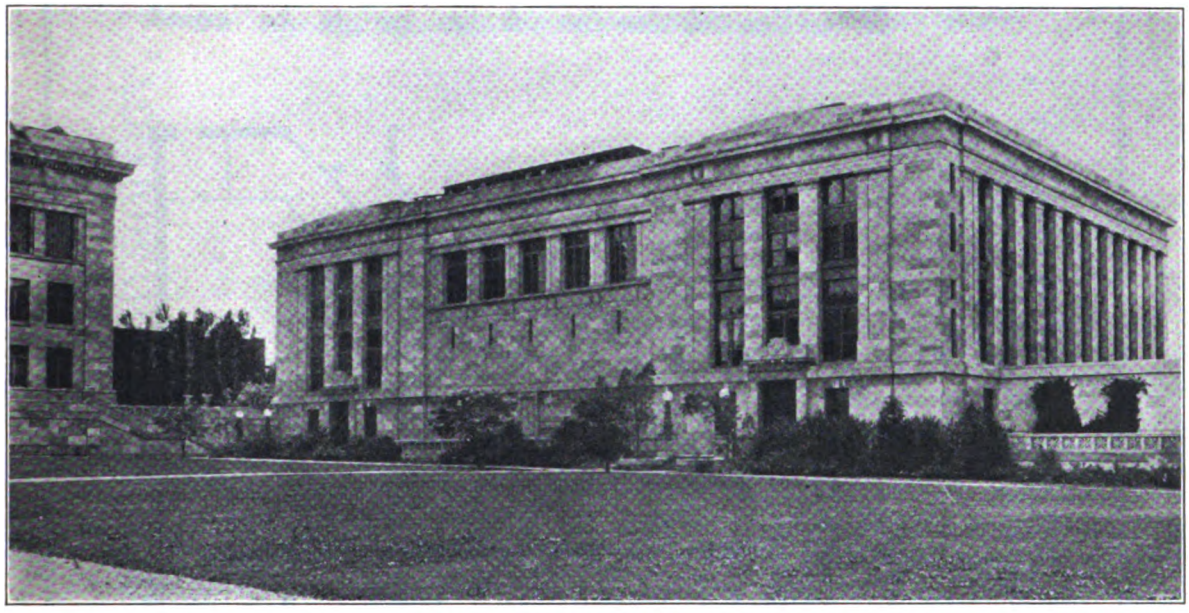

FIG. 1.—PHYSIOLOGY AND BIOCHEMISTRY BUILDING

The oldest of these associated laboratories is the Department of Physiology of the Harvard Medical School. Prior to 1871 instruction in physiology was merged with that in anatomy under the Parkman Professorship of Anatomy and Physiology, created in 1847 and held by Dr. Oliver Wendell Holmes. Between 1865 and 1870 he was assisted by Dr. Josiah Stickney Lombard, who was appointed lecturer, and later, assistant professor, in physiology. In 1870-1871 Dr. William Thompson Lusk (the father of Professor Graham Lusk of Cornell) gave instruction in physiology under the title of lecturer. It is of interest to note that during the three years 1864 to 1867 Dr. Charles Edward Brown-Sequard gave lectures at the Medical School under an appointment as Professor of the Physiology and Pathology of the Nervous System.

In 1871 the title of Dr. Holmes was changed to Parkman Professor of Anatomy, and physi-

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LABORATORIES OF PHYSIOLOGY, HARVARD MEDICAL SCHOOL

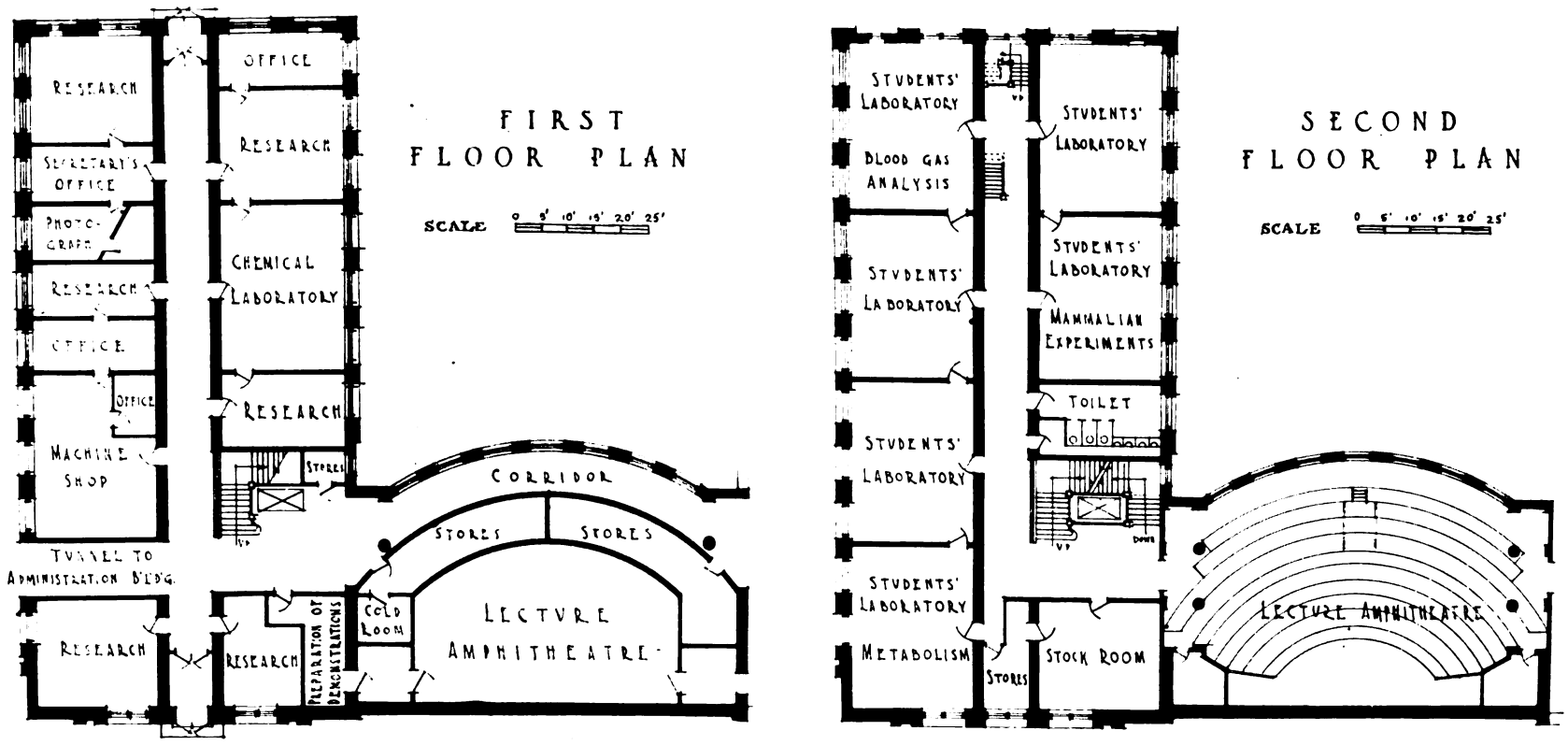

FIG. 2

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LABORATORIES OF PHYSIOLOGY, HARVARD MEDICAL SCHOOL

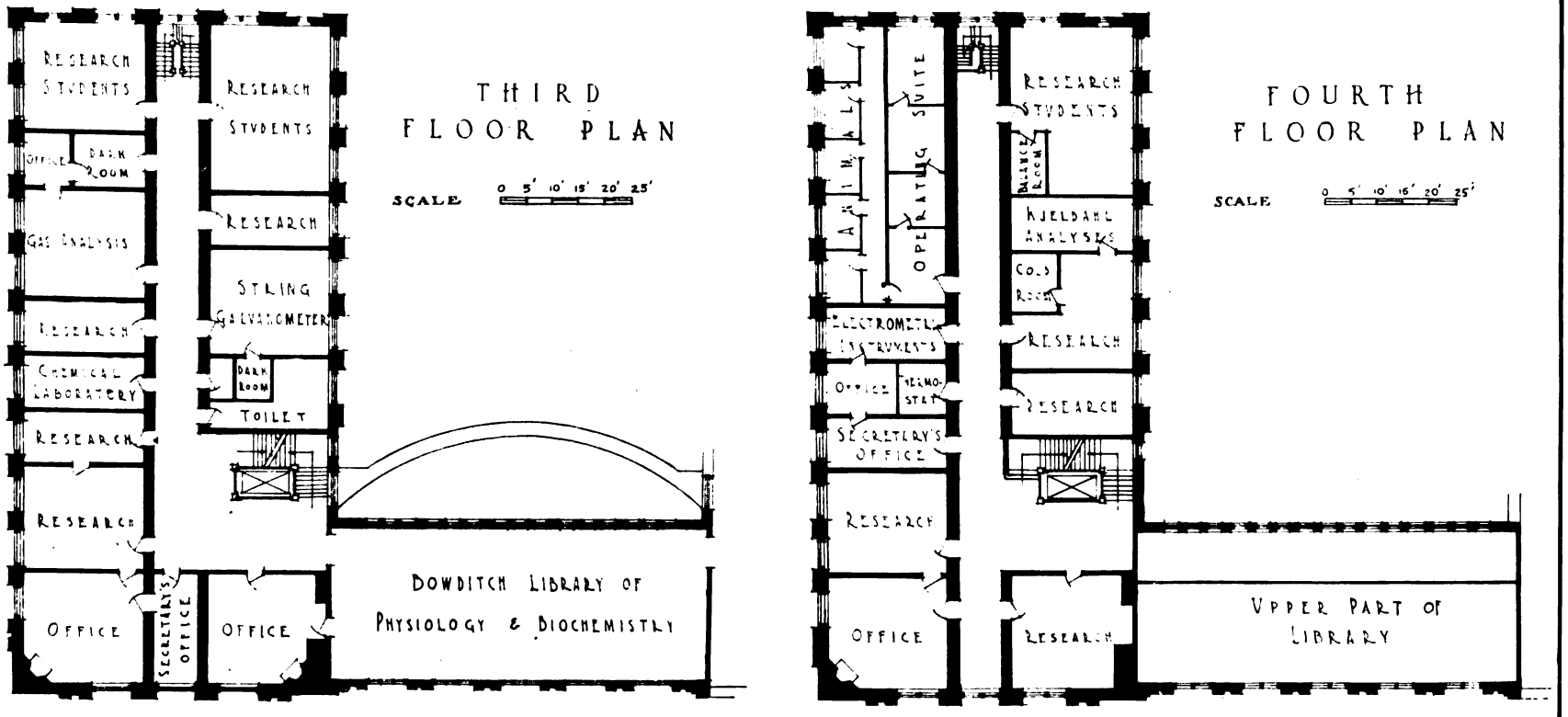

FIG. 3

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ology emerged from its subordinate position, with the appointment of Dr. Henry Pickering Bowditch as assistant professor. At that time there was no physiological laboratory for Bowditch to work in. Two small rooms in the attic of the old medical school building were made over, and in them was placed the apparatus which had been brought back from Germany. "This was the first physiological laboratory, for the use of students, in the United States. These rooms might perhaps be better designated the first laboratory for experimental medicine in this country, for every phase of experimental medical work was represented there within a few years after its establishment." [1] Dr. William Henry Howell was assistant professor in the Department in 1892-1893. He was succeeded by Dr. William Townsend Porter, who in 1899 assumed responsibility for the greater part of the administration of the laboratory. In 1900 Dr. Walter Bradford Cannon joined the staff, and since 1906, as George Higginson Professor of Physiology, has been in charge of the Department.

The Department of Comparative Physiology was established in 1906, and has since been under the direction of Professor W. T. Porter. It is a research department, having no teaching obligations other than the training of investigators.

The Department of Physiology in the Harvard School of Public Health was established with the organization of that school in 1922. It had been functioning as an autonomous organization, entitled the Laboratory of Applied Physiology, since 1918, under the direction of Dr. C. K. Drinker. In addition to the usual research activities of a physiological laboratory the Department offers instruction to students in the School of Public Health. It has also from time to time undertaken the organization of investigations in problems of industrial and public hygiene, where these have promised to have an important physiological bearing. Thus at the present time an investigation of the physiology of lead poisoning is being brought to completion under the direction of Dr. J. C. Aub.

The Department of Physical Chemistry in the Harvard Medical School was established in 1920, with Professor L. J. Henderson at its head. It is concerned with the execution of research and the training of investigators in those aspects of physiology to which the methods of physical chemistry may be applied.

The association of these four laboratories under one roof brings together a larger group of physiologists representing a greater variety of special interests within this field than is to be found elsewhere in this country. Not only is the mass and diversity of intellectual companionship thus afforded stimulating to the individual, but great conveniences and economies accrue. One finds it possible within the group to secure quite expert opinion upon almost any aspect of physiology. In teaching considerable advantages are also gained by this association. Thus the students in the medical course hear lectures not only by members of the staff of the Department of Physiology, but by the senior members of the other departments. The younger members from these departments take part in the laboratory instruction, thereby gaining teaching experience which their own departments could not offer. In several instances men holding teaching appointments from the Department of Physiology in the Medical School are carrying on research work in one or other of the associated departments.

Weekly meetings are held of the entire staff of the associated laboratories and their students, for the presentation and discussion of researches in progress.

The laboratories co-operate from time to time in distributing a list of their publications, which is sent to some two hundred laboratories in this and other countries, with the offer to supply such reprints as are requested. The publication of these pamphlets facilitates the distribution of reprints in an economical manner and at the same time gives wide publicity to the work of the laboratories.

Technical facilities exist in one or other of the laboratories for almost all the usual physiological operations and measurements. By the exchange of technical talent between the various organizations considerable economies are accomplished. Thus the Department of Physiology obtains certain standard solutions from the Department of Physical Chemistry; again, its metabolism technician frequently analyzes gas samples for workers in the other departments. A considerable quantity of equipment is loaned from one department to another, and a certain amount is owned in common. At the present time, for instance, a common source of distilled water is being installed to replace the smaller stills in use by individual departments.

[1] W. B. Cannon. Biographical Memoir of Henry Pickering Bowditch. (In press).

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MATERIAL EQUIPMENT

The Laboratories of Physiology occupy one entire wing of the building in which are also housed the Departments of Biological Chemistry and of Experimental Surgery. The wing is of four floors, each of approximately 2,200 square feet floor area exclusive of corridors.

Teaching accommodations are found on the second floor, where there are six classrooms each of approximately 600 square feet floor area. One of these is equipped for mammalian experimentation, being provided with artificial respiration apparatus, time signals, etc. A second is equipped for metabolism work, with gas analyzers and spirometers. A third room is equipped with blood-gas analyzers and reservoirs for gas mixtures. On this floor are also stockrooms for students' supplies and the storage of chemicals.

The research accommodations of the Department of Physiology in the Medical School are on the third floor. They consist of four rooms, used as studies or offices, two large general laboratories for research students, a chemical laboratory, two dark rooms for photographic recording (one equipped with a Hindle string galvanometer), and various accessories requisite to modern investigation of the neuro-muscular system. On this floor is also a gas analysis room equipped with gas and blood-gas analyzers; a laboratory with equipment for metabolism determination, a closed circuit Benedict apparatus for use with animals, and a Benedict-Roth apparatus. There are also three rooms without special equipment, used as research laboratories by members of the staff.

On the fourth floor is located the operating suite with sterilizing and recovery rooms and six rooms where animals under observation may be kept. On this floor are the departments of comparative physiology and of physical chemistry. The former occupies four rooms including two laboratories fully equipped for mammalian experiments. The Department of Physical Chemistry comprises a large room for research students, equipped with thermostats, hoods, and chemical benches, and an adjoining balance room; a laboratory for general and large-scale chemical preparations, equipped with centrifuges, ovens, etc.; and a laboratory for Kjeldahl and other precise chemical analyses. There is also a room equipped for electrometric measurement, with potentiometers, conductivity apparatus and the like; a gas analysis room; a cold room; a thermostat room, for the precise measurement of solubility; and an office.

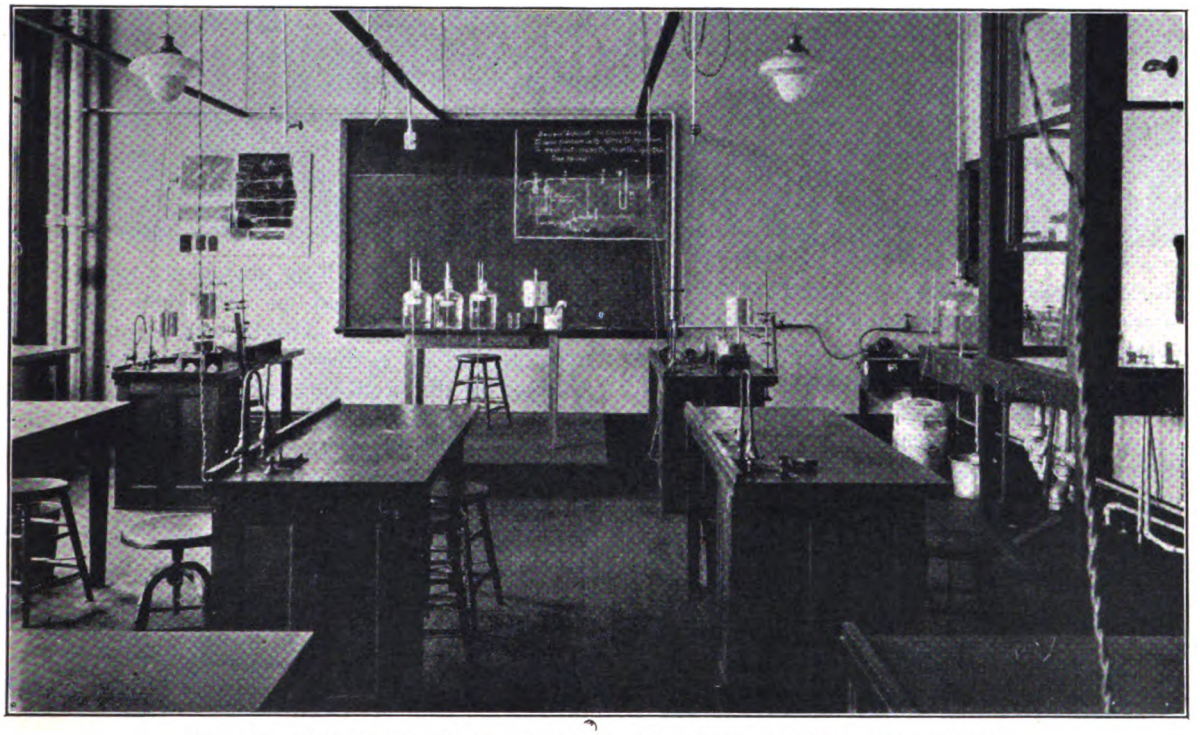

FIG. 4.—STUDENTS' CLASSROOM FOR MAMMALIAN EXPERIMENTATION

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The ground floor is occupied by the Department of Physiology in the School of Public Health. It comprises three offices or studies, one large chemical laboratory, and five research laboratories. The latter are well equipped for mammalian experimentation, being provided with spirometers, perfusion apparatus, and the like for studies of respiration, the circulation of the blood, and the gas exchange in animals.

On the ground floor is also located the machine shop which is not operated by the Laboratories of Physiology, but is maintained for the general use of the Medical School. Adjoining the wing occupied by the Laboratories of Physiology is a large amphitheater seating 262. Over it is located the Henry Pickering Bowditch Library of Physiology and Biochemistry. This library is a branch of the Medical School Library, and contains the files of periodicals on physiology and biochemistry, as well as the special works on these subjects. It contains at the present time 6,602 volumes, 63 periodicals, and a collection of 15,220 reprints.

TEACHING

The Course for Medical Students

Before describing what is being attempted in the teaching of medical students a word or two for the sake of perspective may be of advantage. With regard to the amount and character of the instruction given during Dr. Holmes' professorship it is difficult to speak with precision. "The announcements of the School are couched in very general terms and the personal recollections of that generation of students are naturally . . . quite vague and discordant. Thus statements of the number of lectures on physiology delivered by Dr. Holmes vary from three or four to twenty. A partial explanation of this discrepancy may be found in the fact that physiological phenomena were not infrequently described in connection with structural details. Thus the first five lectures of the anatomical course were mainly devoted to a description of the physical and chemical properties of the elementary tissues of the body such as is usually to be found in textbooks of physiology. Few of Dr. Holmes' lectures were demonstrative in their character, but some of those who attended them can recollect witnessing a demonstration of the lacteals in an animal killed during the absorption of fat and a few simple experiments in artificial digestion."[1]

Dr. Lombard and Dr. Lusk appear to have made free use of the demonstration as a supplement to their lectures and in this way the latter covered the whole subject quite completely.[2] Dr. Bowditch brought this method of instruction to a high state of perfection. He also made a notable contribution to educational procedure by sending students to original sources for the material for physiological theses which they prepared and read before the class.

From 1892[3] and 1896 a small number of physiological experiments were performed by the students themselves. Excepting the year 1892-1893 these experiments were entirely chemical, and in 1896 they were transferred to the Department of Chemistry. Their place was taken by section work in other fields, such as the circulation and the nervous system under the direction of Professor Porter. In 1896 each student spent two afternoons at such experiments; in 1897 and 1898 the time was increased to from two to three hours on twelve afternoons. The class was, however, divided into sections, and the experimentation could not possibly be co-ordinated with the didactic instruction.

The method of teaching physiology was rather completely reorganized in 1899-1900. In the new method, classical experiments in physiology arranged in an instructive sequence, were performed by the student and afterward discussed by the lecturer. In order that the entire class might work through the subject together large quantities of apparatus had to be provided[4], and methods of administration worked out in great detail. The theory underlying the introduction of general systematic laboratory instruction appears to have been that the student learns best by observation and by repetition of the procedures by which knowledge was gained in the

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[1] Quoted from a chapter on "The Department of Physiology" by Dr. H. P. Bowditch and W. T. Porter in *The Harvard Medical School, 1782-1906.*

[2] Physiology at the Harvard Medical School, 1870-1871, *Boston Medical and Surgical Journal,* clxvii, p. 921, 1912.

[3] This is the first year that practical laboratory exercises in physiology are mentioned in the catalogue of the Medical School. Dr. Howell who was connected with the school in 1892-1893 writes that the laboratory course had already been in operation for several years, having been started by Dr. Joseph Weatherhead Warren who served in the department as assistant and instructor between 1881 and 1891.

[4] The Harvard Apparatus Company was the outgrowth of this need. It was organized by Dr. Porter to meet the needs of the Physiological Laboratory. By introducing methods of large-scale production the equipment of the Harvard laboratory was made practical and the inevitable surplus was placed at the disposal of other institutions. The economy effected by this organization must have facilitated greatly the introduction of laboratory instruction throughout the country.

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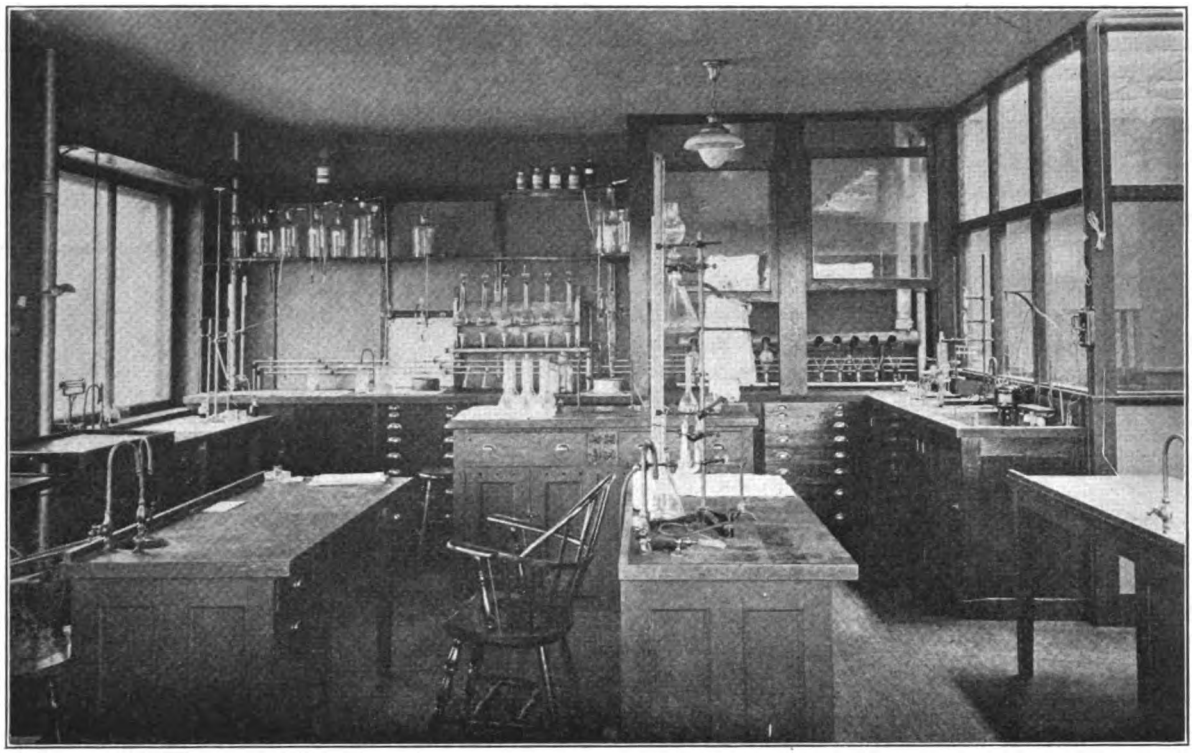

FIG. 5.—LABORATORY FOR RESEARCH STUDENTS, DEPARTMENT OF PHYSICAL CHEMISTRY

first instance.[1] The attempt was made to illustrate the important facts of physiology, whenever possible, by student experiments, restricting the demonstrations to those experiments too difficult for the students to do themselves.

As each year brought about a repetition of the course changes and additions in the detailed experiments were made which improved the quality of the work and extended its scope. Experience accumulated to show, however, that the new method was not entirely satisfactory. From the first the impossibility of covering the entire subject by the objective experiment had been recognized, but physiology itself was growing so rapidly that the futility of attempting to organize the course on this basis became more and more apparent. Furthermore, it appeared that the execution of a well-planned laboratory exercise was a very different thing from the experimental demonstration of a new discovery by an investigator. The more brilliant an experimental proof might be in its simplicity the more trivial it appeared to the student when presented in the laboratory manual. In later years, in attempting to keep the course abreast of modern developments in physiology, a number of experiments were introduced which involved an expenditure in time and equipment much greater than had been customary before. These were experiments on metabolism, the analysis of the blood gases, and certain experiments upon anesthetized mammals. Expense precluded the equipment of the entire class with apparatus for these exercises and as a result they were carried through by small sections of the class in turn. This led to a considerable disjunction of the orderly and logical sequence of laboratory and didactic work which had been developed—a disturbance which did not prove to be particularly distressing, however, to the students. It developed further that these "special experiments," because of the considerable amount of effort which they demanded, were very much more stimulating to student and instructor alike than the shorter exercises to which they returned while other sections were doing the special work. These "special experiments" which had been introduced as an appendage to the main body of the course soon came to sway the whole, while the older, briefer exercises suffered rather demoralizing neglect.

This was the state of affairs in 1921 when the Faculty voted to reduce the number of hours in

[1] W. T. Porter—"The Teaching of Physiology." *Philadelphia Medical Journal*, Sept. 1, 1900.

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the medical curriculum. In reorganizing the teaching of physiology to meet this requirement the plan now in use was adopted. After a preliminary period, during which the entire class works together as before, the "special experiment" is made the basis of the laboratory course. It is expanded to form a block of work on one of the main divisions of the science. Four such sections have been organized, and are equipped to occupy one quarter of the class—which is now limited in number to one hundred and twenty-five students.

The details of this organization are set forth in the catalogue of the Harvard Medical School as follows:

PHYSIOLOGY A

Lectures and laboratory work. *Second half-year. Mondays from 9 until 12:30 and from 2 until 4; Wednesdays, from 9 until 12:30; Fridays from 9 until 12:30 and from 2 until 4.*—Drs. Cannon, Redfield, Stiles, Ray, and Davis, assisted by other members of the staff.

The following objects govern the presentation of this course in physiology.

1. To acquaint the student with the method of experiment as applied to the acquisition of knowledge of physiological facts and to teach him how such facts may be correlated so as to explain physiological phenomena.

2. To cause the student to perform a series of experiments which demonstrate the more fundamental concepts of physiology which will help him to understand the phenomena of health and disease in man, and in the case of those phenomena which fail to lend themselves to such treatment to present in the lecture room an exposition of the experimental procedures from which the concepts have arisen.

3. To train the student to correlate his knowledge of the physiology of the different parts or systems of the organism into an understanding of its activity as a whole, and to show him the utility of applying physiological concepts to the study of medicine.

The first three weeks are devoted to the first of these objects. In the laboratory a series of experiments will be performed which, while designed primarily for training the student to handle living tissue, to make and interpret graphic records, and to draw from experiment a deduction concerning the phenomenon in question, will serve to demonstrate the chief facts on which our conceptions of the nature of excitation, conduction, and response to muscle and nerve are based. In the accompanying lectures and conferences the student will be shown how these facts may be correlated and applied to the elucidation of the co-ordinate activity of the heart and the neuro-muscular mechanism.

At the end of this period the class will be divided into four sections of approximately thirty men each. Every section will devote three weeks to each of the following series of laboratory exercises.

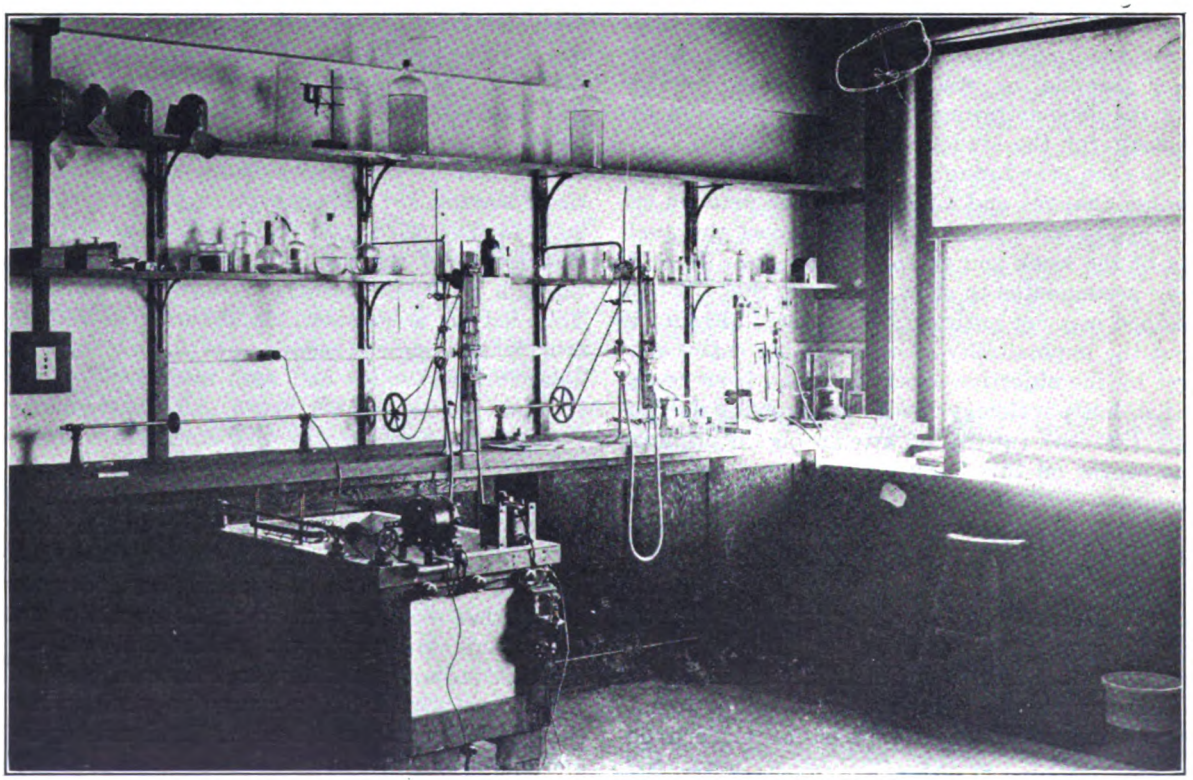

FIG. 6.—GAS ANALYSIS ROOM, DEPARTMENT OF PHYSIOLOGY, MEDICAL SCHOOL

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1. *The Circulation of the Blood.*—Experiments illustrating the events of the cardiac cycle in the reptilian and mammalian heart, the factors controlling the pressure and flow of blood in the arteries and veins, the nervous control of the circulation, and the effects of the circulation on the activities of muscles and glands will give the student extensive experience in the performance of operative procedures upon anesthetized mammals. The principles thus brought out will be applied to the interpretation of experiments performed upon the students themselves with methods adapted to the clinical study of the circulation.

2. *Metabolism and Respiration.*—Experiments illustrating the fundamental facts concerned in the gaseous exchange of the body are particularly well adapted to train the student in the use of quantitative methods in the study of human physiology. They will include a study of the method of gas analysis, the determination of basal metabolism, the measurement of the tension of the gases in the alveolar air and in the venous blood, the estimation of the output of the heart per minute, the effect of exercise upon the factors concerned in the gaseous exchange, the chemical control of the ventilation of the lung, and the determination of the efficiency of methods of artificial respiration. In addition, the nervous control of the pulmonary ventilation and the gas content of the arterial and venous blood under various conditions will be illustrated by experiments and demonstrations on an anesthetized mammal.

3. *The Blood and Body Fluids.*—Experiments illustrating the carriage of oxygen and carbon dioxide by the blood, the fundamental facts of the acid base equilibrium, the physiological importance of the physical properties of the body fluids, i. e., osmotic pressure, salt content, temperature, etc., the coagulation of the blood, the regulation of its water content by the kidney, the secretion of lymph, and the properties desirable in solutions used for transfusion.

4. *The Central Nervous System and Special Senses.*—Experiments illustrating the principal conceptions concerning the properties of the reflex arc and the integration of reflex activity in the central nervous system, the functions of the higher nervous centers, the nature of voluntary and reflex movement and of the maintenance of posture, the control of visceral organs by the autonomic nervous system, the phenomena of refraction in the eye, the function of the semi-circular canals and the properties and distribution of sensory end-organs in the skin.

Each of these series is in the charge of a senior member of the staff assisted by a teaching fellow who will explain and discuss the experiments in informal lectures and conferences, will demonstrate certain experiments which cannot be readily performed by the students themselves, assign reading from a standard textbook, and give references to monographs and original papers relating to the subject, and at the end of each series examine the students on the work which they have been over.

While this experimental work is in progress formal lectures will be given twice a week in which will be treated the interrelation of the various subjects studied in the laboratory. These lectures will treat also of the physiology of those phenomena on which no laboratory work is given, such as the digestive system, the endocrine glands, the regulation of body temperature, the cerebro-spinal fluid, etc.

Each student is required to write a thesis, based upon the result of consulting a number of original papers on some aspect of physiology or biochemistry.

The working out of this plan of instruction has been given careful scrutiny and the judgment of the staff has been supplemented by a report made each year by a committee of students. The result has been sufficiently satisfactory to lead to its continuance during the past year, and it will be tried again with only minor modifications during 1924-1925. The following, quoted from a report made by the Department of Physiology to a committee to visit the Medical School, appointed by the Board of Overseers of Harvard University, is of interest in giving comments on the working out of some of the details.

"The reduction in the number of exercises has caused the elimination of all but the most fundamental experiments. The reduction has been carried to such a point that the student has time to work at a given experiment until he has satisfied himself that it has been done well. As a result the quality of the work done in the laboratory has materially improved and with it the morale of the class. The granting of a whole day to physiology on Monday and Friday has been of especial value in allowing the students to bring their technique to some degree of perfection.

"The system of dividing the class into small sections and making the laboratory rather than the lecture work the backbone of the course has brought the student into closer contact with his senior instructors than heretofore. Much time previously devoted to formal lectures is now used for informal conferences with small sections of the class—a form of exercise which students and staff agree to be particularly helpful.

"The students are no longer required to hand in notebooks describing their individual laboratory experience. Instead, each group of five students who have worked together, prepares a report each week on their joint efforts. It is believed that this system has led to no greater abuses than the former, and that it has certain distinct advantages. Students are led by it to consider together the implications of their work —many groups regularly setting aside time on their free afternoons for this purpose. The fivefold reduction in the number of laboratory reports now makes it possible for the teaching staff to correct the reports with great care, and in this manner check up on and extend the success of the laboratory teaching.

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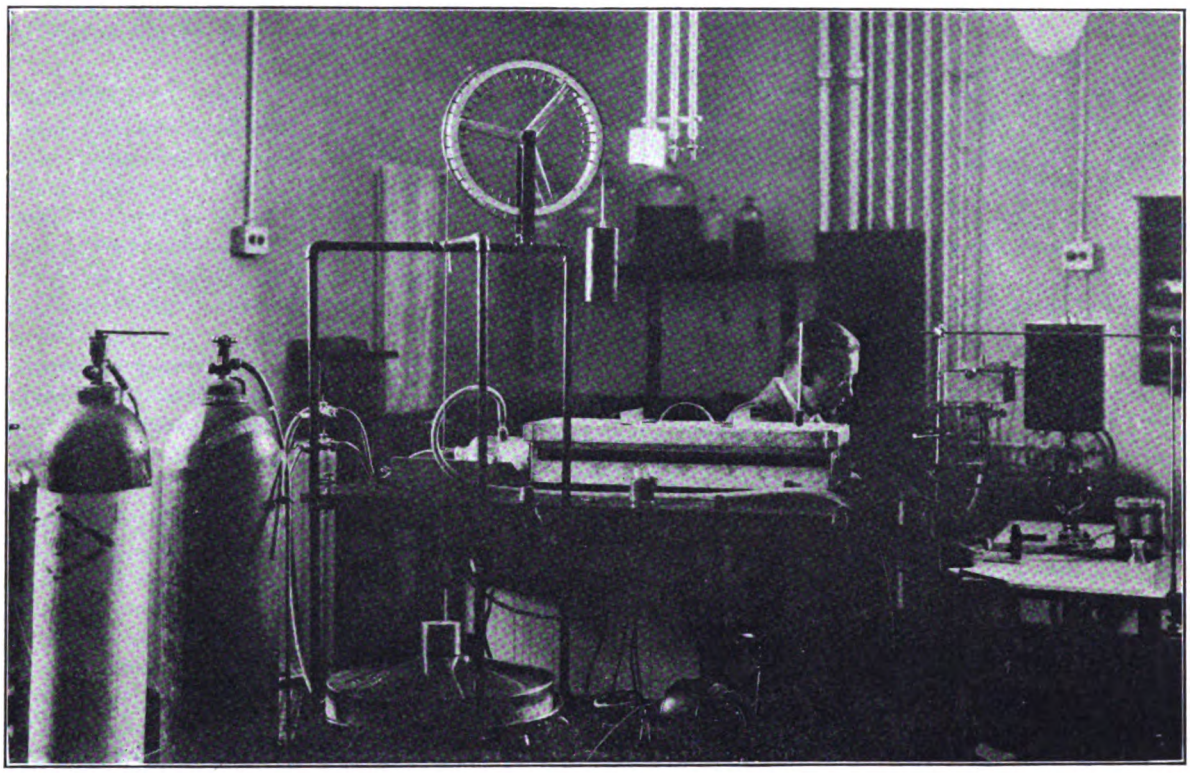

FIG. 7.—RESEARCH LABORATORY, DEPARTMENT OF PHYSIOLOGY, SCHOOL OF PUBLIC HEALTH

"The system has necessitated the repetition of each section of laboratory-teaching four times. While this has had the disadvantage of becoming somewhat irksome, it has made it possible to improve the laboratory procedure with each repetition. It has also provided machinery for the training of the junior instructors who have been able to take on greater and greater responsibility as the year has progressed and as they have gained in experience under the guidance of their seniors.

"In résumé, it is believed that we have been able to reorganize our teaching so that a twenty-five per cent reduction in the number of hours assigned to required exercises has in no way led to a reduction in the standards of the course, but rather to an improvement in the quality and quantity of the student's physiological equipment."

Further comments in connection with the teaching of physiology to medical students will be found below in the section on the Tutorial System.

Formal laboratory instruction in physiology is also presented in the course for dental students and in the summer course for graduates. A detailed description of these will be found on a preceding page (page 27). In general they are modeled after the course for medical students, but are somewhat more limited in scope and more elementary in character. The course presented by the Department of Physiology in the School of Public Health is designed to meet the special requirements of students in that institution. It is described in the catalogue of the School of Public Health.

Biological chemistry and pharmacology are now taught by independent departments in the Medical School.

ADVANCED COURSES

The general reduction in the curriculum which went into effect two years ago provided for every medical student a certain amount of time which could be used entirely according to his option. The Laboratories of Physiology arranged a series of eight courses of lectures and demonstrations on special topics in physiology which were given during 1922-1923. These courses were designed to give an opportunity for upper-class men in the school to review physiology in their free time. Attendance was optional, and no examinations were held or grades given. The courses were attended by ninety-one different

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persons on one or more occasions who were classified as follows:

Medical Students	
First year	4
Second year	13
Third year	16
Fourth year	3
Students in School of Public Health	6
Members of staff, graduate students, laboratory technicians	26
Miscellaneous	22

The number attending each course varied from seven to forty, the average being twenty. The numbers indicated that a demand exists in the Medical School for exercises outside of those dictated by the curricula of technical education, and that efforts to meet this demand would receive a gratifying response from a limited group of students. The courses were continued during the past year, and will be given again in 1924-1925. Each year the subjects are changed, as may be seen by the following:

Courses given in 1922-1923:

October—Dr. Drinker, circulation.
November—Dr. Henderson, the physical chemistry of the blood.
December—Dr. Redfield, respiration.
January—Dr. Aub, metabolism and nutrition.
February—Dr. Cannon, the endocrine glands.
March—Dr. Cohn, the physical chemistry of physiological processes.
April—Dr. Forbes, the fundamental principles underlying the activity of the nervous system.
April—Dr. Porter, demonstrations in mammalian physiology.

Courses given in 1923-1924:

October—Dr. Henderson, the physical chemistry of the blood.
November—Dr. Hecht, the physical chemistry of the visual process.
December—Dr. Cohn and Dr. Ferry, the physical chemistry of physiological processes.
February—Dr. Stiles, human nutrition.
April—Dr. Porter, demonstration in mammalian physiology.

Courses to be given in 1924-1925:

October and November—Dr. Redfield, reading on respiration and the respiratory function of the blood and organs of circulation.
November—Dr. Henderson, the history of the biological sciences.

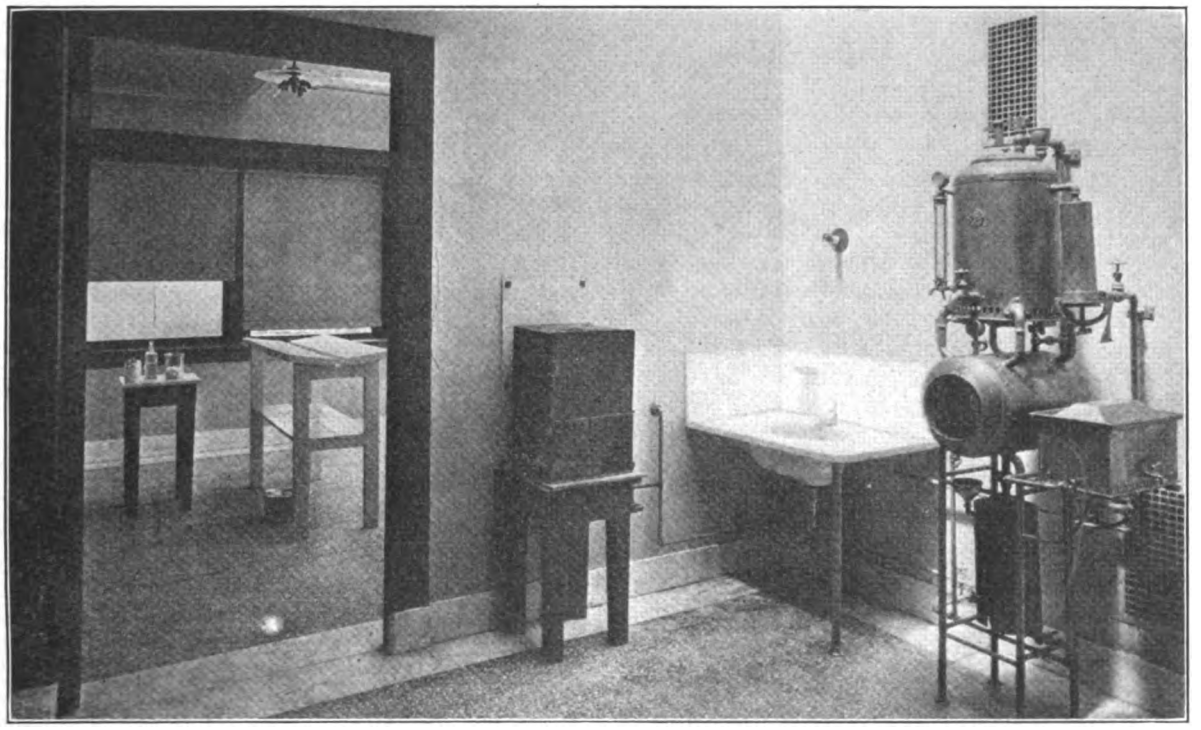

FIG. 8.—OPERATING SUITE

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FIG. 9.—A PROFESSOR'S STUDY

December—Dr. Cohn, the physical chemistry of the proteins.

January—Dr. Homer Smith, the permeability of tissues to electrolytes and non-electrolytes.

February—Dr. Forbes, the fundamental principles underlying the activity of the nervous system.

March—Dr. Fairhall, food and nutrition.

April—Dr. Porter, demonstrations in mammalian physiology.

TUTORIAL SYSTEM

During the past year (1923-1924) provision has been made to give especial opportunity and stimulus to the most capable students in the Medical School to develop their power for advanced and concentrated work. To this end Dr. Redfield has been assigned to act as tutor in physiology. Three classes of students have come under his guidance.

Fourth-year students in high standing are permitted to devote a considerable part of their time to elective study. One student elected four months of physiology, in which time he was able to study exhaustively the physical-chemical system of gas transport in a vertebrate animal, and bring his results into a condition worthy of publication. A second student elected one month[1] of physiology and used this time to complete some experiments begun during his spare time in the earlier years of the course.[2]

Ten second-year students elected to work under the tutorial system in the spare time afforded by the two free afternoons provided by the rearrangement of the curriculum. The accomplishment of many of these men was negligible for one reason or another, but three at least demonstrated that, if given suitable problems to work upon, very respectable achievement can be made by a determined student in the available time of this year. In handling such students it has been held advisable to avoid organized series of lectures or conferences or any form of group instruction, as the regular curriculum already affords an excess of this sort of intellectual exercise. Each student or pair of students is given an individual problem to investigate. Experience in the first year has suggested that it is better to give a rather definite problem for immediate experimental attack to be followed by wider reading, than to reverse the process. A number of men who were given rather general reading to do in preparation for a more specific experimental investigation, found it difficult to do this type of work in the face of the competi-

[1] It is not the intention to permit students to elect physiology for periods of less than four months, except in special cases.

[2] The results have been published. See Cattell and Stiles, *Science*, lix, No. 1530, p. 383-384.

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tion for their spare time offered by the regular work of the curriculum. Those who were engaged with specific tasks in the laboratory did not yield to the temptation to give up this work to prepare themselves better for their various term-time examinations.

In directing the work of these students the tutor has conceived that his duties are simply to enable capable students to carry out any kind of individual effort in which they might be interested, provided only that the object did not appear to be obviously futile and that the students' abilities be such that their regular work in the School does not become unsatisfactory as the result of the diversion. He does not attempt to direct all of the work of these men himself but to get them in touch with whatever member of the faculty is best fitted for their specific needs. In this connection the word "physiology" is interpreted broadly to include all of the premedical sciences. During the past year men have been placed for work in the departments of anatomy, biological chemistry, and physical chemistry, in addition to physiology.

While it was not the original intention to have men in the first year of the medical course participate in the tutorial system it has already proved practical to include them, and indeed desirable to devote considerable effort in preparing men during this year for further participation in the system. During the past year three first-year medical students who had had some previous training in physiology were permitted to work at original problems in the laboratory. Of these men, two have since left the School to continue their physiological studies in Oxford and Cambridge Universities. The third engaged in physiological research during the summer at Woods Hole.

In addition to these, eight men were selected from the first-year class and given a course in physiology which was in the nature of a pedagogical experiment. The object of the experiment was to determine the effect of substituting rather close personal contact for formal instruction, and the replacement of much of the laboratory experimentation by organized reading in monographs and original papers. To this end there were selected as subjects men from colleges in all parts of the country, and men whose premedical records varied from the highest to those which were merely average. They were excused from all regular work in the physiology course, but were advised to attend the lectures and required to take the examinations. Each week one experiment was performed—arranged to occupy the greater part of a day and to illustrate some general type of physiological phe-

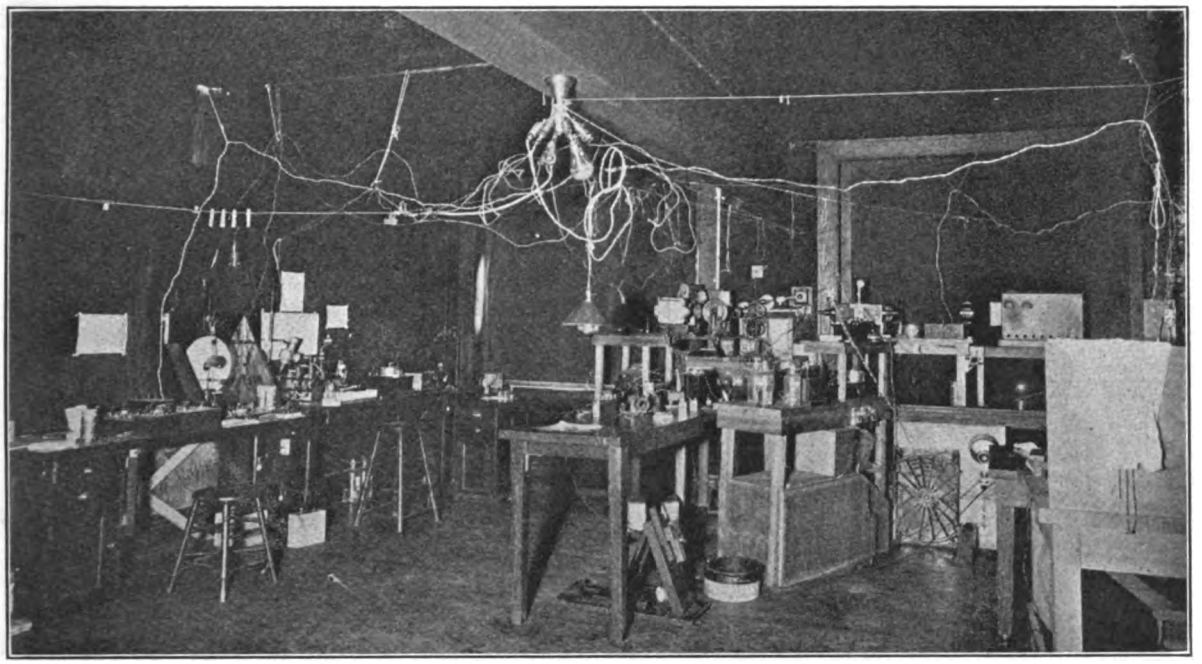

FIG. 10.—STRING GALVANOMETER ROOM

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nomenon. At the end of each week several hours were devoted to a conference in which the experiment and the reading which had been done on the general subject which this experiment illustrated were talked over informally. At this conference a syllabus of the next week's work was given out and discussed. It contained not only directions concerning the experiment, but references to reading and a list of detailed topics which were intended to suggest to the student the things which he should understand as the result of his reading. The references were always more extensive than could be covered in the available time—so that the student was forced to select for himself—guided however by certain verbal recommendations from the tutor. The amount which was read was surprisingly great—150 to 200 pages a week, in addition to the textbook, in such works as Lusk's "Science of Nutrition," Haldane's "Respiration," Barcroft's "Respiratory Function of Blood," Bainbridge's "Physiology of Muscular Exercise," Krogh's "Anatomy and Physiology of the Capillaries," as well as "Harvey Lectures," articles from the "Physiological Reviews," and the like.

In spite of the fact that no effort was made to prepare them for the examinations which were given for the main body of their class these men were able to compare very favorably with their fellows in this type of competition. Certainly their reading was broader and all agreed that they had not felt the want of more extensive experimental experience in order to appreciate this reading. Considering the method as a stimulant it is sufficient to point out that four of the eight men have expressed their intention of taking up investigative work in their free time during the coming year. The experiment will be repeated in 1924-1925.

Concerning the objects of the tutorial system in general, it has seemed necessary to state—to counteract a misinterpretation frequently put upon it—that it is not intended to wean men away from medicine into the premedical sciences, but rather to aid in what must become more and more a general object in medical education, the sending into medicine of men with scientifically trained minds. Emphasis is placed on experimentation because, of all the scholarly disciplines, it seems best fitted to attract the interest of the student. Original discovery and its publication is stressed only because these objects in

FIG. 11.—HENRY PICKERING BOWDITCH LIBRARY OF PHYSIOLOGY AND BIOLOGICAL CHEMISTRY

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experimentation convert the discipline into an accomplishment worthy of pursuit for its own ends, and confronts the student with the reality of the advancement of knowledge.

RESEARCH

It is a general policy that members of the staff shall have at least one half of their time free for research.[1] In addition to the independent work done by the staff, fourteen students have been working during the past year at research problems under the guidance of its members. These may be classified as follows:

Junior members of staff, not candidates for higher degree, five; junior members of staff, candidates for higher degree, three; fellows of the National Research Council, two; research fellows of the Rockefeller Foundation, four. Some idea of the scope of the research interests represented by the members of the staff is given by the following:

Department of Physiology

Professor W. B. Cannon. The mechanical factors of digestion, physiology of emotional states, the endocrine glands particularly the adrenals and thyroid, the regulation of sugar metabolism and of body temperature, hunger, thirst, peripheral inhibition, muscular fatigue, and traumatic shock.

Dr. Alexander Forbes. The physiology of nerve and muscle and its application to the behavior of the central nervous system.

Dr. A. C. Redfield. The physiological action of radiations, and the general and comparative physiology of the circulatory and respiratory systems.

Dr. P. G. Stiles. The physiology of the neuromuscular mechanism.

Comparative Physiology

Professor W. T. Porter. Circulation and respiration in pneumonia, traumatic shock, growth of children.

Department of Physiology (School of Public Health)

Professor C. K. Drinker. Physiology of bone marrow, pulmonary circulation, the heart, circulation in muscle, industrial problems such as dust hazards, metallic poisoning.

Dr. J. C. Aub. Metabolism and endocrine glands, lead poisoning. Dr. Aub has recently been appointed assistant professor of medicine; but he will retain an unofficial connection with the Department of Physiology in the Medical School, where he will direct certain investigations in endocrinology.

Dr. L. T. Fairhall. The physiological aspects of the chemistry of lead, nutritional chemistry.

Physical Chemistry

Professor L. J. Henderson. The acid-base balance, physical chemistry of blood, the history and philosophy of science.

Dr. E. J. Cohn. The physical chemistry of the proteins and its relation to the physiology of cell and body fluids.

Dr. R. M. Ferry. The physical chemistry of blood and hemoglobin.

STAFF

The staff of the various departments for the year 1923-1924 was as follows:

Department of Physiology: Professor, Walter B. Cannon; assistant professors, Percy G. Stiles, Alfred C. Redfield; associate professor, Alexander Forbes; instructor, Hallowell Davis; teaching fellows, C. J. Campbell, David Brunswick, H. O. Veach, Howard B. Hunt.

Department of Comparative Physiology: Professor, William T. Porter.

Department of Physiology, School of Public Health: Professor, Cecil K. Drinker; assistant professor, Joseph C. Aub; instructors, L. T. Fairhall, G. B. Ray, L. A. Shaw, J. T. Wearn; assistants, W. B. Castle, P. Reznikoff.

Department of Physical Chemistry: Professor, L. J. Henderson; assistant professor, E. J. Cohn; research fellow, R. M. Ferry.

These workers are aided by the following technical staff:

Department of Physiology: Two secretaries; two technicians; three laboratory attendants.

Department of Comparative Physiology: One technician; one technician and secretary.

Department of Physiology (School of Public Health): Two full-time secretaries; one part-time secretary; three technicians; three full-time laboratory attendants; one part-time laboratory attendant.

Department of Physical Chemistry: Three chemical assistants; one laboratory attendant.

Adding to these a number of individuals working without official status or as graduate students, fellows of the National Research

[1] None of the staff are engaged in the private practice of medicine. All of the members are, or have been from time to time, connected with one or another of the Boston hospitals.

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Council,[1] and research fellows of the Rockefeller Foundation,[1] the total number engaged in investigation, teaching, and administration during 1923-1924 in the Laboratories of Physiology was approximately fifty-eight.

BUDGETS

The following table gives the budgets of the various associated departments for 1924-1925. It is not possible to separate the funds devoted to teaching from those devoted to research. It may be pointed out that the major expense of teaching is borne by the Department of Physiology in the Medical School.

	Salaries	*Technicians, Other Services and Wages*	*General Expenses*	*Total*
H.M.S.				
Physiology ..	$22,600	$7,836	$5,000	$35,436
Comparative physiology.	4,800	840	800	6,440
Physical chemistry.	4,800[2]	4,740	2,960	12,500
S.P.H.				
Physiology..	14,400	5,270	3,830	23,500[3]
Total	$46,600	$18,686	$12,590	$77,876

[1] These are customarily appointed research fellows by the University, which gives them the privileges of official status.

[2] Supplemented by $8,300 from the Department of Chemistry.

[3] During 1923-1924 and the preceding two years this figure was supplemented by $17,000 devoted to an investigation of lead poisoning.

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UNIVERSITY OF GRONINGEN PHYSIOLOGICAL INSTITUTE

(PROFESSOR F. J. J. BUYTENDIJK, DIRECTOR)

BY

J. DE HAAN, M.D.

HEAD OF DEPARTMENT, LECTURER IN GENERAL BIOLOGY

The Physiological Institute of the University of Groningen, described in the following pages, was erected in 1911 to replace the institute built in 1866, which at the time was the first Dutch laboratory devoted exclusively to physiology. The three other Dutch universities soon followed suit. In view of the enormous development of physiology in ensuing decades, it is no surprise that this modest building soon became inadequate. Shortly after the late Professor Hamburger accepted the chair of physiology at Groningen in 1901, he succeeded in convincing the government of the total insufficiency of the facilities available at that time, and moneys were voted for the building of a new institute on magnificent lines. The Director spared no pains to make the new building a model research institute. During the preparatory years, numerous existing institutes were visited and the entire staff gave its whole-hearted co-operation in constructing and equipping the building. On April 7, 1911, it was opened and has therefore been in use for almost fourteen years. During this time there has been plenty of opportunity to

FIG. 1.—PHYSIOLOGICAL INSTITUTE

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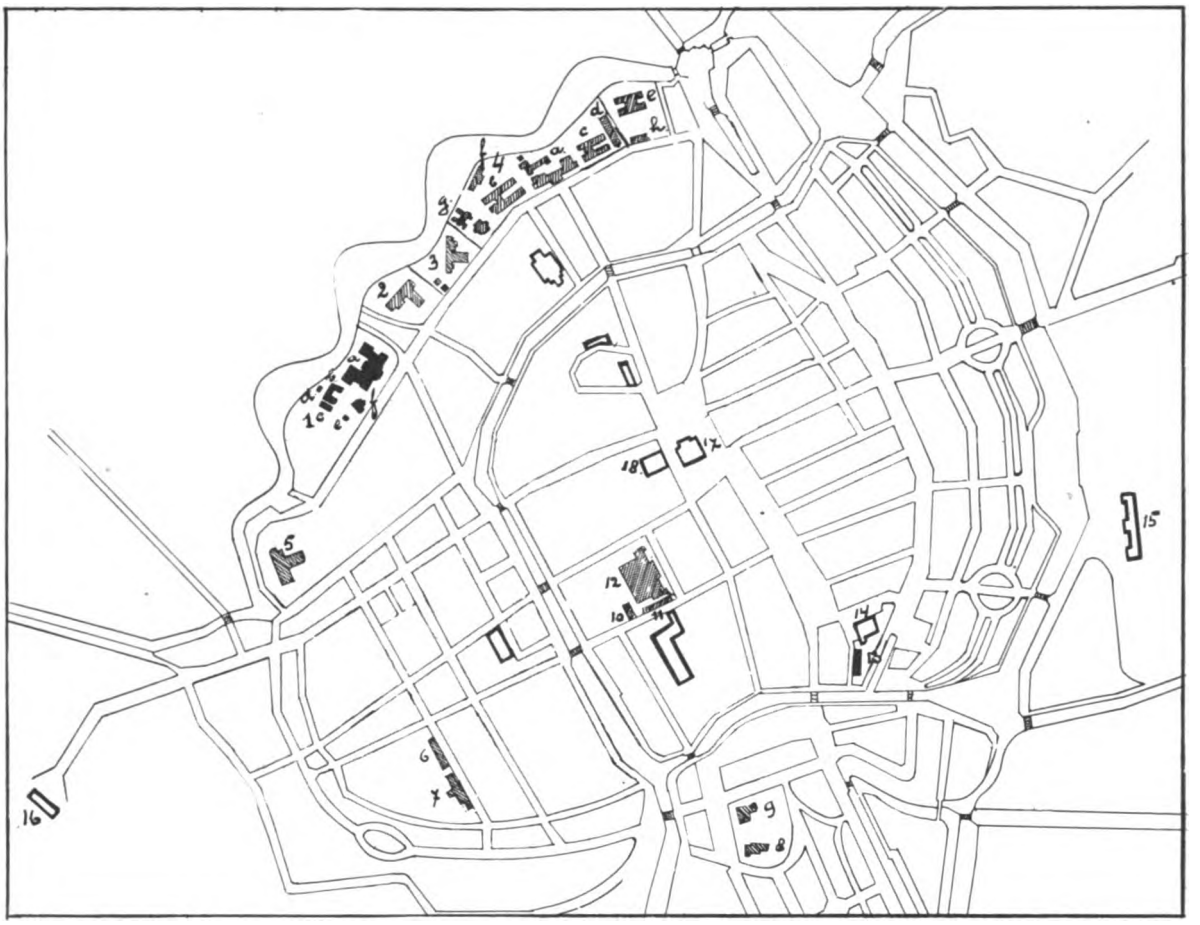

FIG. 2

1. Physiology—(a) Main building, (b) Stable, (c) Storage, (d) Rabbits, (e) Glass room, (f) House for custodian
2. Anatomy and embryology
3. Pathology
4. University hospital—(a) Main building, (b) Medicine, (c) Surgery, (d) Gynecology and midwifery, (e) Neurology and psychiatry, (f) Otorhinology, (g) Infectious diseases, (h) Radiology
5. Chemistry
6. Pharmacy
7. Botany
8. Mineralogy
9. Physics
10. Astronomy
11. Bacteriology and hygiene
12. University building
13. Zoology
14. Postoffice
15. Railway station (south)
16. Railway station (north)
17. Town hall
18. Students' club

be grateful to the founder for the unusually generous provisions for research. Many scientists have worked in the Institute and made use of its facilities. During the course of the years certain shortcomings have naturally come to light, but on the whole it can be said that Groningen, as the first of the Dutch universities, has been enriched with an institution that from a great many points of view can still be considered a model one.

As the instruction and research work in physiology, physiological chemistry, and histology, including microscopic anatomy, is united under one professor at the University of Groningen, the Institute has necessarily to mold itself to some extent on the requirements of each of these subjects, both as regards instruction and research work.

DESCRIPTION OF THE BUILDING

The main building is a three-story structure composed of a central section and two wings. It

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is located on fairly extensive grounds which, by furnishing a pond for frogs, pasturage for large experimental animals, hutches and feed for rabbits, as well as other conveniences, are made to contribute toward meeting some of the needs of the Institute. The general layout of the buildings and grounds is given in the accompanying plot plans (see Figs. 2 and 3).

The first story comprises a lecture room, a class histological laboratory, a demonstration theater, and a number of smaller laboratories and rooms. The lecture room (1) and the histological laboratory (12) are lighted from three sides. The former is especially adapted for instruction by cinematograph, a device which serves excellently to demonstrate all kinds of living movements including those observed under the microscope. The films are developed on the premises. Adjoining the lecture hall is a small room for preparing the material to be shown at the lecture (2). On this floor there is also a library (5), forming a department of the University Library. There is also in the balance room (6) a modest collection of books, periodicals, pamphlets, and prints, most of them belonging to the Director. By keeping them here they can be made of wider use than they would be in the professor's home. Each of these libraries has a separate, carefully prepared card catalogue.

The demonstration theater (7) is built on the usual plan, with seats rising in tiers each one-half meter above the other. Facilities are provided to permit the microscopic and other preparations to be viewed by students who cannot do so sufficiently during the demonstration period.

There are three laboratories for general research purposes—one (9) for general workers and for those working for their doctor's degree, another small laboratory known as an assistants' laboratory (10), and the Director's private laboratory (4). Each of these contains such facilities as centrifuges, air pressure and suction, and ovens for various temperatures, so that they can be used for researches of every kind.

The ground floor has a students' laboratory for physiology (17) and another for physiological chemistry (14) and between the two a dark room (16) for spectroscopic examinations of the blood, ophthalmoscopy, and other uses, and a glass-washing room (15). These connecting rooms are used for both laboratories. One corner of this floor is taken up by two rooms for making

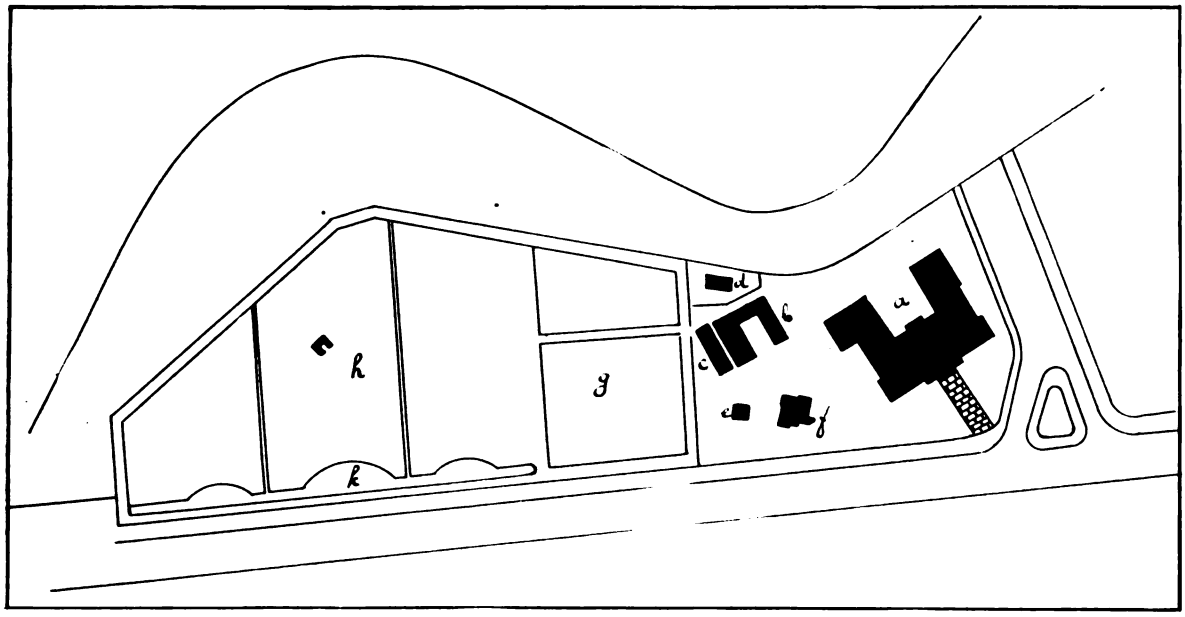

FIG. 3

a. Main building
b. Stable
c. Storage
d. Rabbits
e. Glass room
f. House for custodian
g. Greens and clover
h. Pasture
k. Pond

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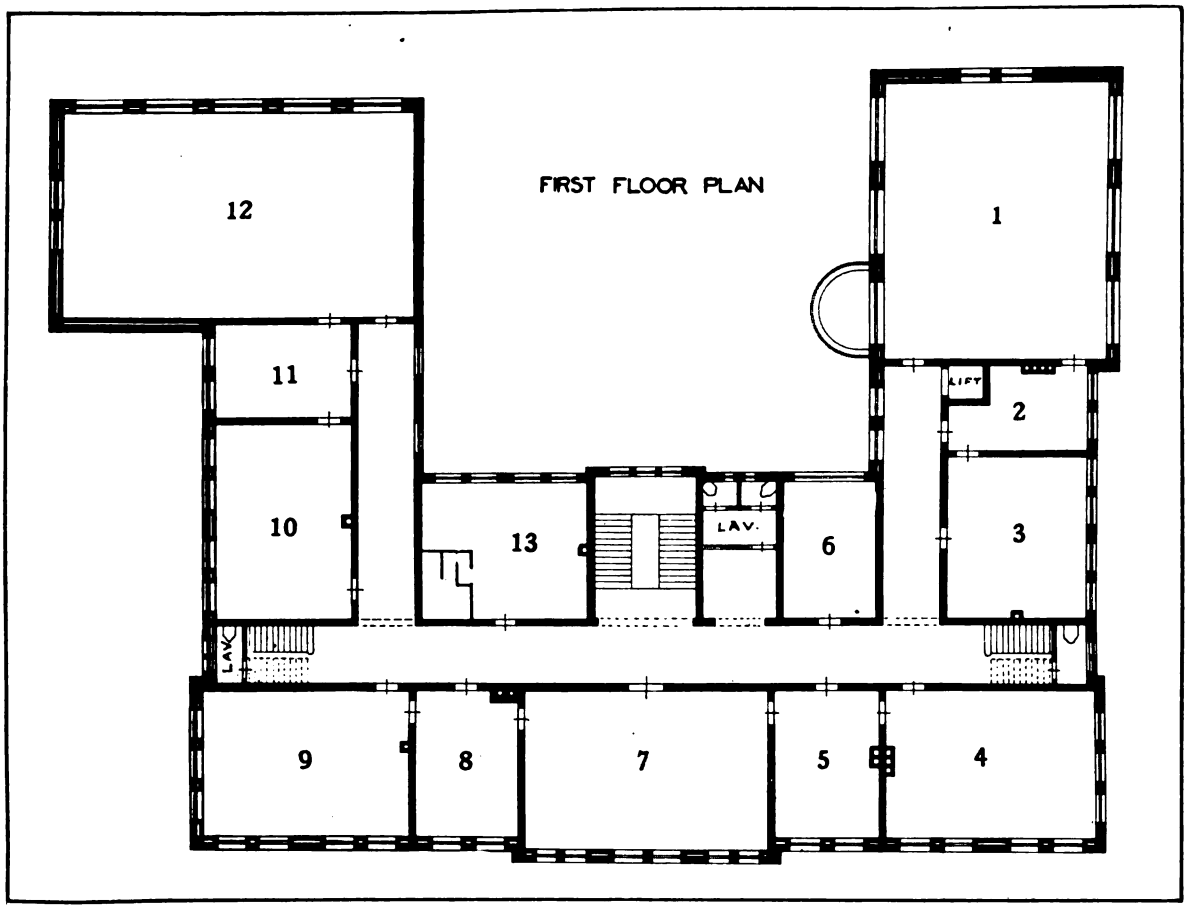

FIG. 4

1. Lecture room
2. Lecture preparation room
3. Professor's private room
4. Professor's laboratory
5. Library
6. Balance room and library
7. Demonstration theater
8. Assistant director's private room
9. General laboratory
10. Assistants' laboratory
11. Histology preparation room
12. Histology classroom
13. Drawing and photography

instruments (18, 19). These are well equipped for constructing both heavy and light apparatus. Grinding and polishing machinery, an electric bath for plating, and other facilities are provided. Other corner sections are taken up by the bacteriology laboratory (24) and a large room used for operations and experiments upon both small and large animals (28). The latter has a special apparatus for fastening large animals, such as horses, in any given position without danger to operator or animal. A 7,000 c.p. electric illumination makes possible cinematographic reproduction of vivisection and other experiments. Adjoining is a room for sterilization and bandages (29), another for preparing animals for operations (27), and next to this a third for observation of animals under research (26).

There is also on this floor a room (30), which can be completely darkened, for optical researches such as spectroscopy and polarization. It is also meant to be used for researches on animals with X-rays. The enormous progress in Röntgen technique renders it possible to study the movements of the intestinal tract, heart, lungs and other organs cinematographically, before and after operations, and thus to submit them to an analytical investigation. The funds necessary to equip this room were not available until recently.

The basement, in addition to the engine room (39), refrigerating plant (37), and various storerooms, contains three laboratories, one for electrophysiology (34), one for low temperatures (38), and one for body temperature (40).

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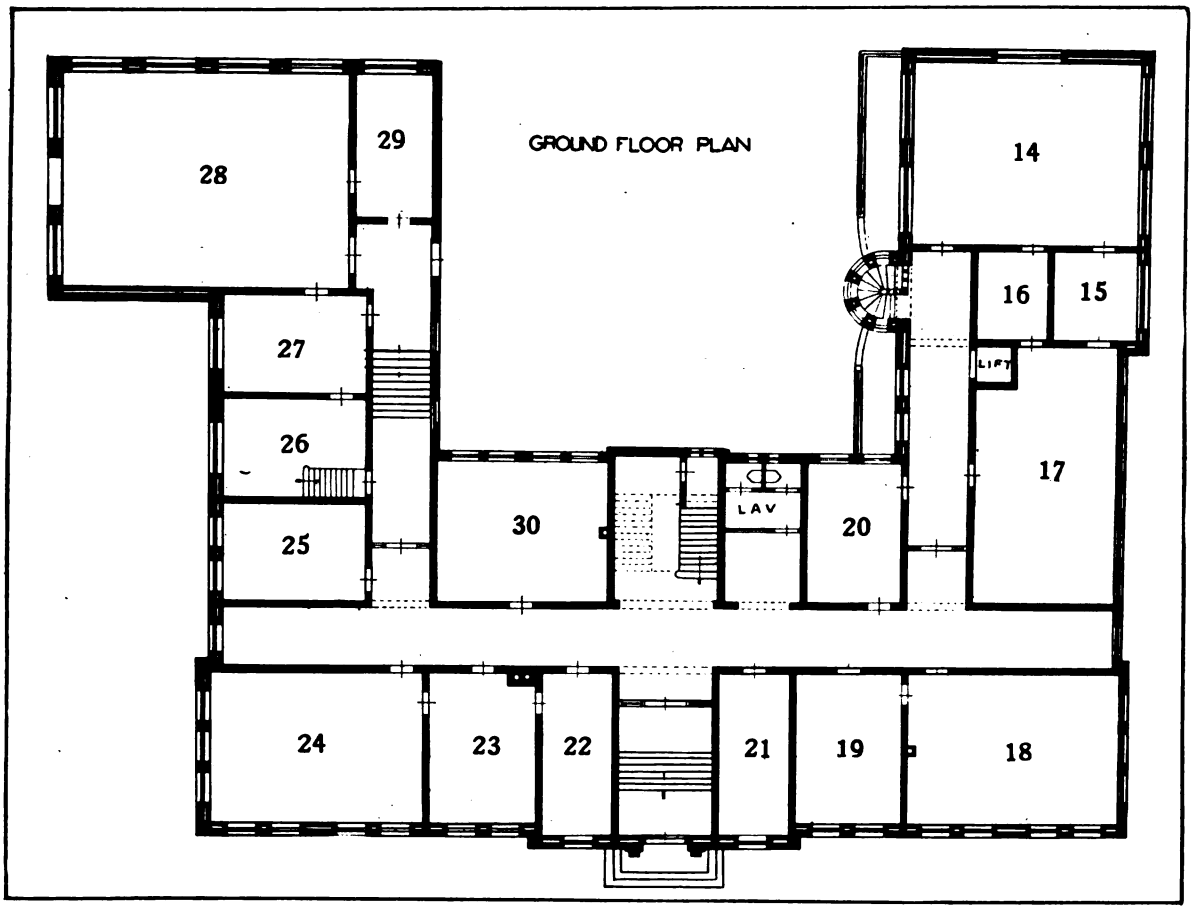

FIG. 5

14. Class laboratory for physiological chemistry
15. Glass washing
16. Dark room
17. Laboratory for physiology class
18 and 19. Shop for making apparatus
20. Assistant's private room
21. Reception room
22. Storeroom and glass washing
23. Assistant's private room
24. Bacteriological laboratory
25. Physicochemical research room
26. Observation room for animals
27. Preparing animals for operation
28. Operations and physiological experiments
29. Sterilization and bandages
30. Optical researches

The low temperature laboratory has facilities for preserving serums and organic materials that cannot be used immediately. It also contains a refrigerating machine for making the ice used in the laboratory for various purposes. The chief use of the room, however, is to carry on experiments at low temperature; this is especially useful in connection with enzymes which decompose more rapidly at room or body temperature than at one of about 0° C. The study of chemical reactions at a given low temperature would be impossible if the precipitates, obtained at low temperature, were removed by centrifugation at the ordinary room temperature. An electrical centrifuge has therefore been provided, as well as various other auxiliary apparatus.

A large room across the corridor (41) contains various kinds of centrifuges, a large installation for ultrafiltration, a Buchner press for making juices, an apparatus for distilling water, and the machines for the general suction and pressure systems, taps for which are found in various rooms. Adjoining this room is a smaller one (41a) which serves as a store for various objects required for experiments with the large machines in room 41; it also offers an opportunity of studying results without being troubled by the noise and stamping of the machines. A printing machine for the prompt printing of

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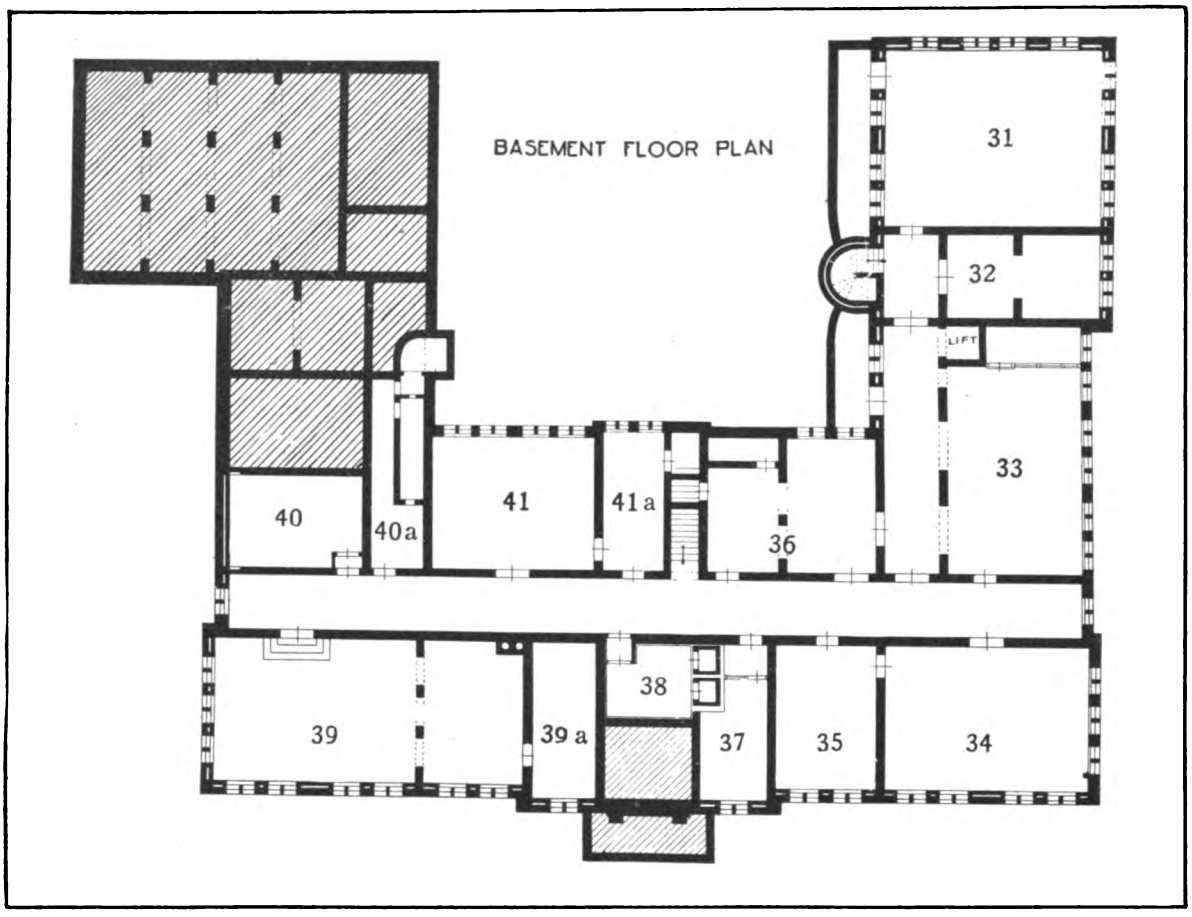

FIG. 6

31. Bicycles
32. Storeroom
33. Storeroom for glass and chemicals
34. Electrophysiology
35. Gas, water, and electric meters
36. Packing rooms
37. Refrigeration machine
38. Low temperature laboratory
39. Engine room
39a. Carpenter shop
40. Laboratory for body temperature
40a. Engine room for room 40
41. Centrifuge room
41a. Annex of room 41

labels, and so forth, is also located in this room.

It is well known that vital processes, and chemical processes in general, are in a high degree dependent upon temperature. In the laboratory for body-temperature (40) the temperature can be minutely regulated and, if necessary, kept at a given point. This room, which is provided with taps for compressed air and suction, electric centrifugal apparatus and a current transformer, has also been found of service in studying the organs of warm-blooded animals after they have been taken from the body. If the isolated organ is to be kept alive it is absolutely necessary that the temperature should not fall below that of the body. Apparatus for this purpose, which is difficult to devise, is rendered superfluous by this room. The way in which constancy of temperature is obtained has been very much simplified since the building was put into use. Other temperatures between 20° and 40° C. may also be obtained in this room.

A large corner room (34) on this floor is designed for electrophysiological researches and is equipped with the necessary apparatus such as a string galvanometer, etc.

Near the main building and standing by itself is a small building known as the glass room (see Fig. 3) which may be used for experimenting with the effects of sunlight on life.

One wing of the stable (see Fig. 3) is reserved for small animals, the rest being used for horses, cows, sheep, goats, etc. It has a

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separate heating system and is lighted by electricity. Near the stable is a rabbit burrow with appropriate grounds enclosed by a fence. The custodian, who is at the same time chief clerk, lives in a detached house (see Fig. 3). This arrangement was thought preferable to providing living quarters in the main building.

The grounds attached to the laboratory have an area of 1.3 hectares and include a clover field, a field for cultivating vegetables for small animals, and a pasture for the large ones which are kept in good hygienic condition. Inside the grounds is a pond in which fish can live throughout the winter, a part of it being reserved for frogs. Thus the laboratory has a constant supply of aquatic flora and fauna in natural condition.

TEACHING METHODS AND FACILITIES

To prevent loss of time in searching for apparatus and material or getting them from other rooms every room is well provided with all the ordinary supplies and appliances, including the equipment necessary for simple vivisection and the preparation of microscopical slides. Filter paper of different sizes and degrees of hardness is kept in the drawers of the work table in flat round boxes made of zinc fastened to the bottom of the drawer. These boxes are fitted with lids to keep the filters in place and clean.

The cinematographic facilities, the instrument shop, the regulated temperature rooms and the extensive grounds which in various ways are made to contribute to the needs of the Institute have already been mentioned.

The card catalogue of the two libraries embodies a principle that has been applied to all objects on the premises. This system it is believed contributes a great deal to the orderliness and neatness of all the rooms. The cupboards and every shelf in them are provided with white enamelled plates bearing black letters or numbers which give a fixed place to all objects. Everything, if possible, bears the number of its room, the letter of its cupboard, the number of its shelf, and the place number on this shelf. When anything is taken from its place a printed card is substituted on which is recorded the borrower's name and the room to which it has been removed. When the object is returned a record is made on the card, which is then put in a box kept for this purpose.

Each room has an inventory book in which are entered alphabetically the contents of the room

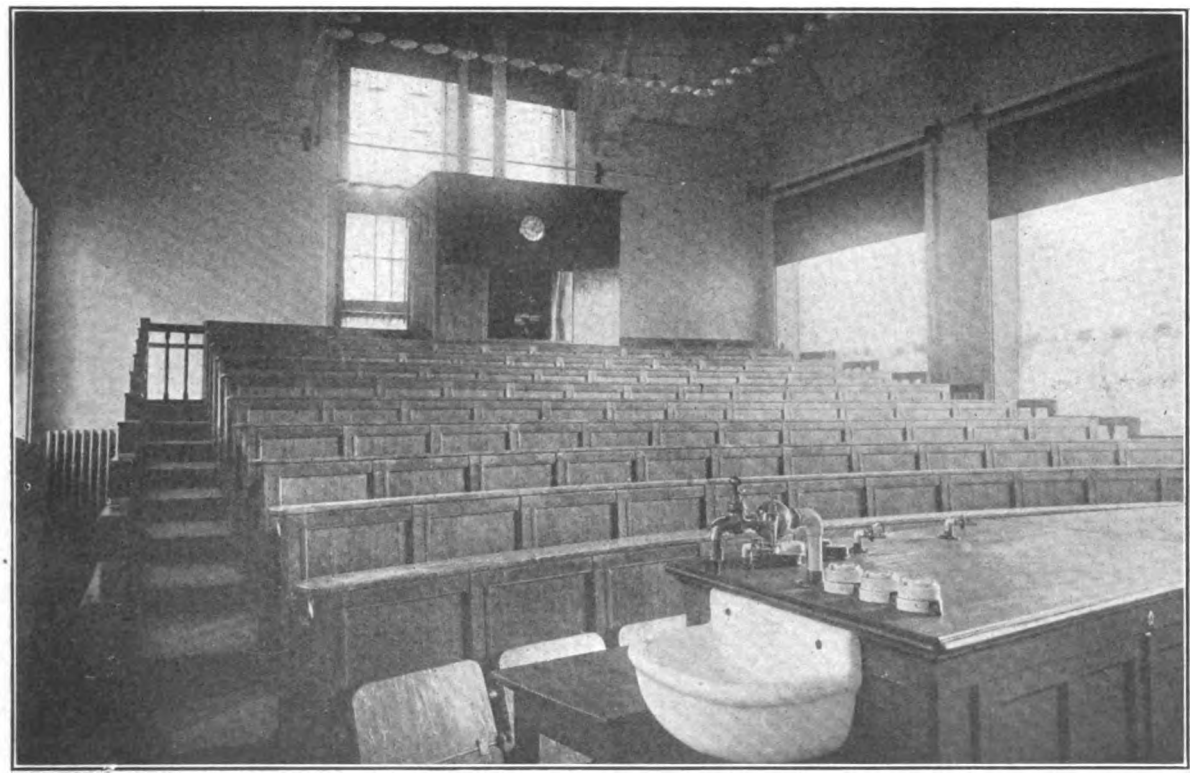

FIG. 7.—LECTURE ROOM

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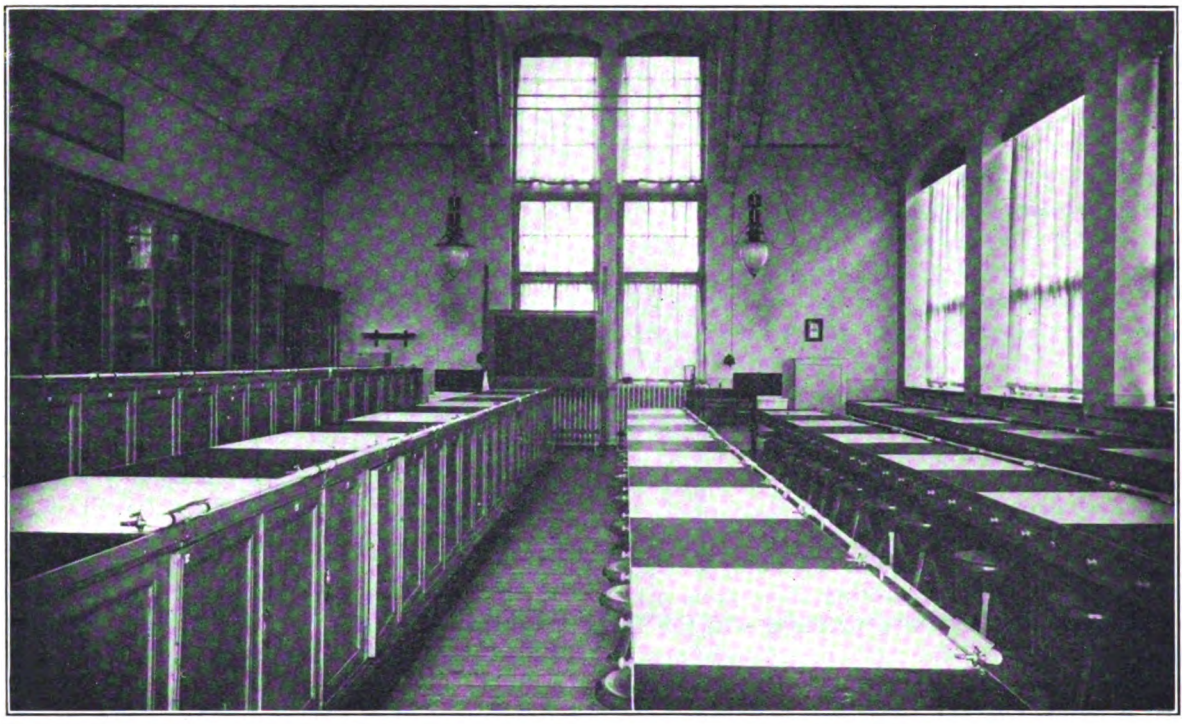

FIG. 8.—HISTOLOGY CLASSROOM

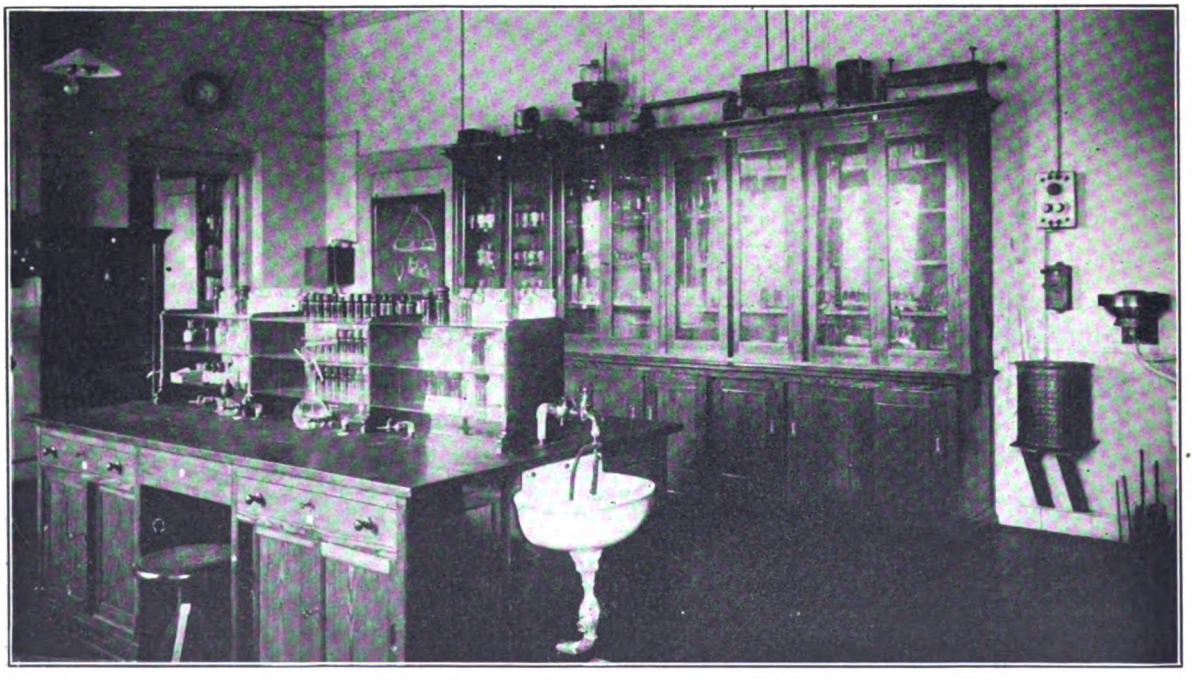

FIG. 9.—PROFESSOR'S LABORATORY

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with indications of their proper places. Every room also has a so-called breakage book, in which students and personnel make a record of what has been broken so that it can be replaced as soon as possible from the central store.

To further facilitate the finding of objects there is a complete inventory in card catalogue form on each floor, so that every worker can find his way about perfectly from the first day he enters the laboratory. A clerk is provided to attend to the work of keeping up these card catalogues.

The fact that all laboratory necessities are liberally provided and that everything has been done on the part of the late Director to promote order, cleanliness, and neatness, causes every one to feel a moral obligation to co-operate in the same spirit. Experience indicates that the system works well.

Another convenience is the telephone system. In a large building it is difficult to locate a person by telephone if he is moving about from one room to another. In the Institute the house telephones have been constructed so that every instrument produces two tones, one high and one low. If the Director wishes to speak to an assistant, he sounds the combination of tones assigned to him. These particular tones are simultaneously reproduced by the thirteen other telephones distributed over the building. No matter what part of the building he may be in he will know that he is wanted and will go to the nearest telephone. A special tone or combination of tones is assigned to every member of the scientific and technical staff and a list of these signals hangs at the side of each telephone. It might be supposed that the frequent ringing of these telephones and the necessity of being on the lookout for calls would be annoying. Experience has shown, however, that this is not the case. In such rooms as the lecture rooms the telephone may be temporarily disconnected when desired.

FIG. 10.—CLASS LABORATORY FOR PHYSIOLOGY

HISTOLOGY

As stated above, both histology and microscopic anatomy are taught in the physiological laboratory. Formerly this was the case everywhere, but gradually a division has taken place at most universities. From a purely scientific point of view much may be said in favor of such a separation. More justice is done to histology, since it obtains workers who devote themselves exclu-

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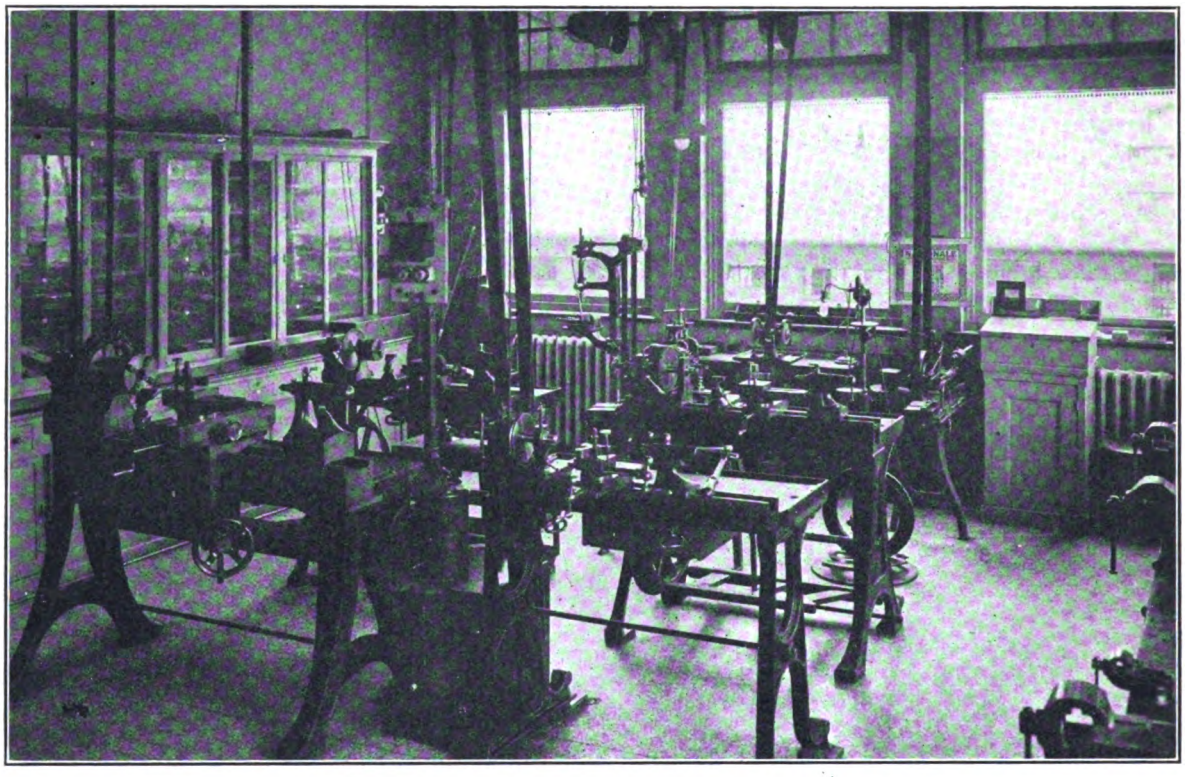

FIG. 11.—SHOP FOR MAKING APPARATUS

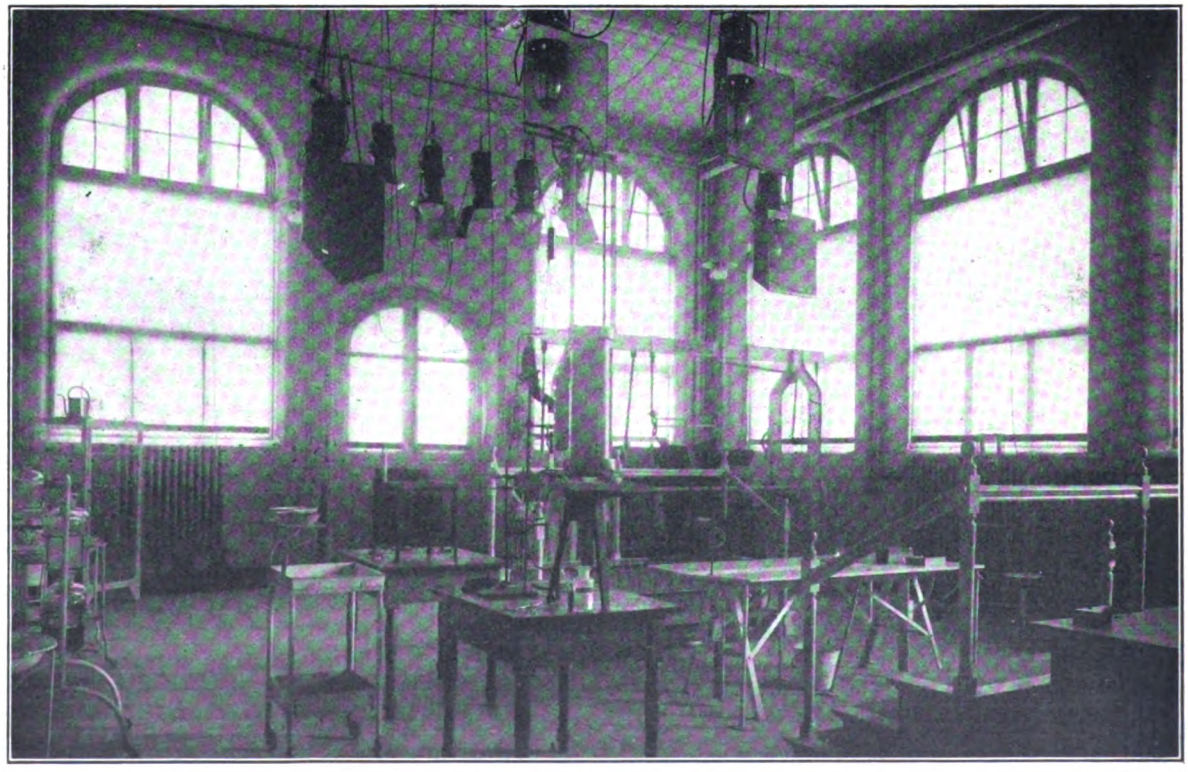

FIG. 12.—OPERATIONS AND PHYSIOLOGICAL EXPERIMENTS

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sively to it. In the interest of teaching, however, such a division is less desirable because morphological facts are of interest to the medical student only when considered in connection with living processes. This consideration has prevented the transfer of elementary instruction in histology and microscopic anatomy to another institute.

Bacteriology

It is sometimes thought that bacteriology concerns only the hygienist and pathologist. Bacteria, however, are also of interest to the physiologist. In the first place, millions are found in the intestinal tract of a healthy man, and, secondly—and this is of even greater importance—the physiologist must frequently reckon with bacteria as unwished-for guests which often form a disturbing element in his investigations. The lower organisms, found everywhere in the air, infect the body-fluids with which he works, feed and multiply at the expense of these fluids, and even secrete various substances modifying their composition.

It is necessary, therefore, to keep these lower organisms away from the fluids, and to do this efficiently, the worker ought to have at his disposal a room especially adapted for this purpose and provided with the usual appliances required for the study of infectious diseases and their prevention.

Of the many investigations in physiology which have to be carried out by sterile methods, mention may be made of the study of enzymes which are found in great variety in the cells and fluids of the body, and are daily becoming of more importance to biology. Another example is the production of antibodies. The mechanism of these antibodies is extremely complicated, especially when they are formed by bacteria. The substances playing a part in this process are of many kinds and it is only with great difficulty that they can be obtained in a free and pure state. It is advisable to introduce the simpler substances into the body, and thus turn the problem into one of a chemicophysiological nature. The conclusion is that serum therapeutics and immunity, which are virtually based on physiological reactions, certainly concern the physiologist as much as they do the pathologist and hygienist.

RESEARCH

As regards the principles that have guided research work in this institute for some ten years or more, it should be noted, as has already been pointed out, that physiology proper, physiological chemistry, and histology have all been brought together under a single professorship. Every physiological investigation must take these two allied sciences into account. In general it can be said that the aim has been to approach physiological problems from the chemical and physicochemical side, keeping in mind at the same time histological physiology, that is to say, whatever the histological picture as it varies during the course of the physiological experiment can teach the physiologist concerning the function of the organ studied. A number of publications that have appeared since the erection of the institute bear witness to this trend.

PERSONNEL

The scientific staff consists of the Director, a head of department (lecturer in general biology), a conservator, two assistants, and three voluntary assistants who help with the laboratory and classwork of the students, the rest of their time being devoted to research work of their own. All their time is given to teaching and research. There is also an assistant for research and administrative work only.

The technical staff consists of four well-trained men, two of whom are detailed for work in the instrument shop and are in charge of various apparatus, and two who do work of a clerical nature and give technical help in experiments. There are, besides, a farm-laborer, a charwoman, and two apprentices.

BUDGET

Professional staff	f22,500
Technical staff	12,510
General maintenance and research	13,996
Total	f49,006

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WESTERN RESERVE UNIVERSITY SCHOOL OF MEDICINE DEPARTMENT OF PHYSIOLOGY

BY

CARL J. WIGGERS, M.D.

PROFESSOR OF PHYSIOLOGY

1. THE FUNCTIONS OF A PHYSIOLOGY DEPARTMENT

The subject matter of the physiological sciences has become so extensive and the methods of investigation in particular fields so specialized that, in the great majority of our medical schools, the Department of Physiology no longer embraces the sciences of biochemistry, pharmacology, and experimental medicine. This is the case at the School of Medicine of Western Reserve University. The policies and plans outlined in this paper must therefore be interpreted as applying only to the Department of Physiology proper.

In a modern medical school such a department has three main functions: to offer students the broadest training in the application of physiological principles in medicine, to contribute actively and regularly to the advance of physiological knowledge, and to develop physiologists of the future among the junior staff.

EDUCATIONAL POLICY

No question in medical education is more discussed than that of the content of a laboratory subject in a school of medicine. There seems to be a growing belief that, in our zeal to present the fundamental subjects fully and completely,

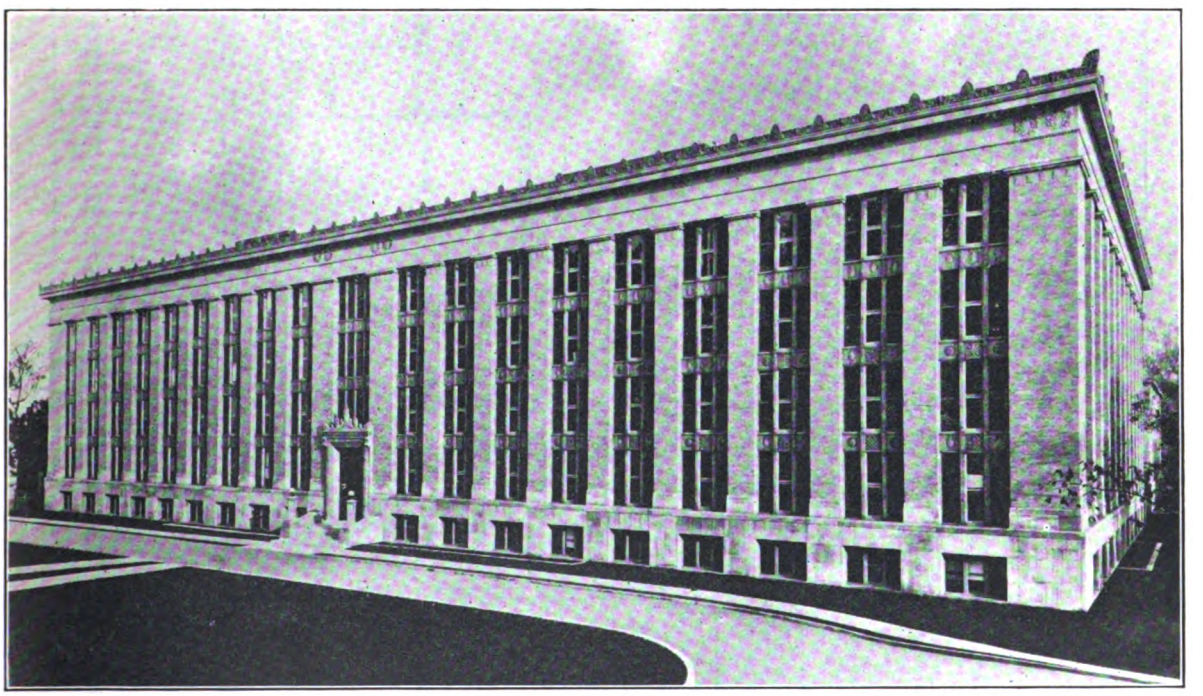

FIG. 1.—SCHOOL OF MEDICINE, WESTERN RESERVE UNIVERSITY

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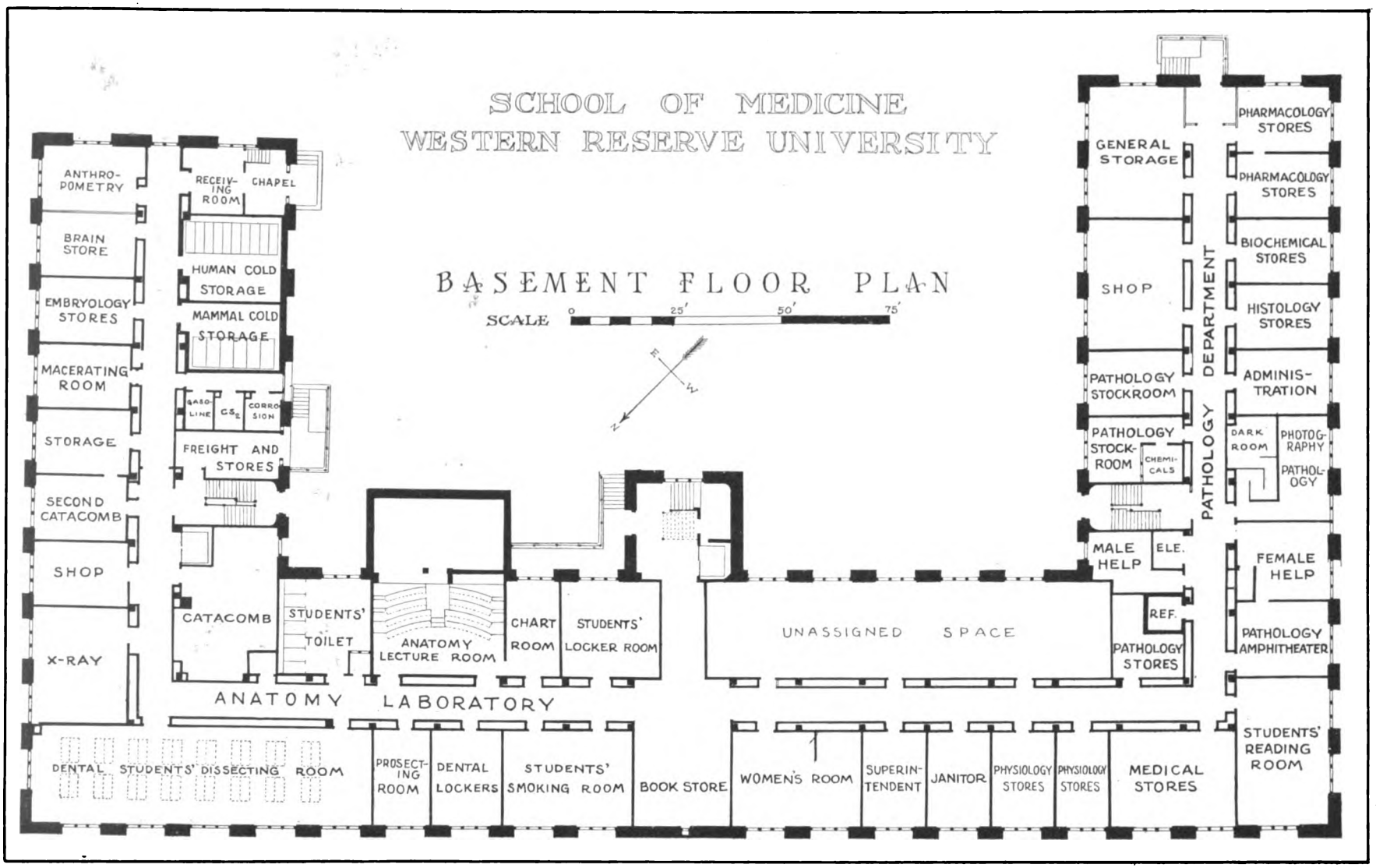

FIG. 2

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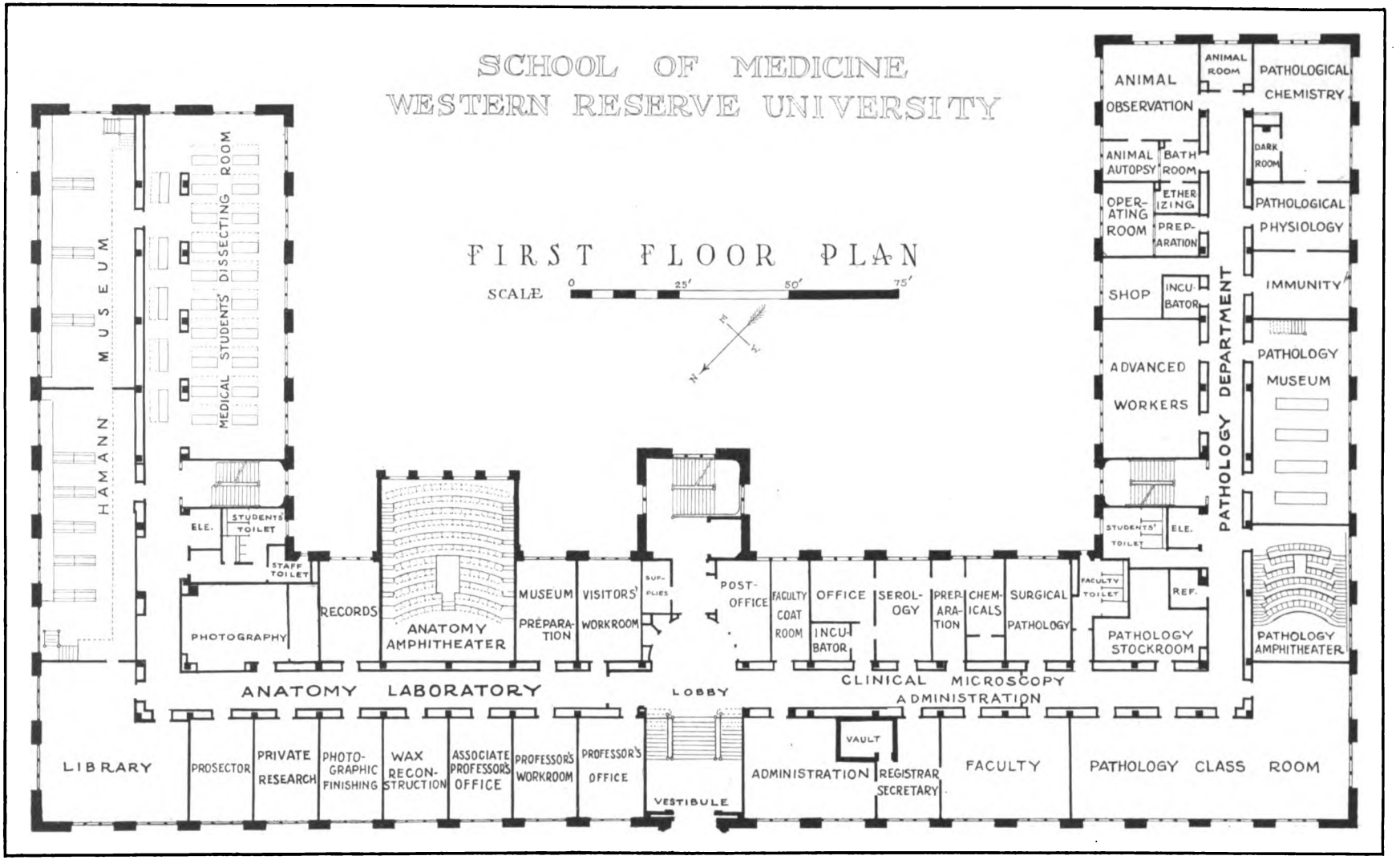

FIG. 3

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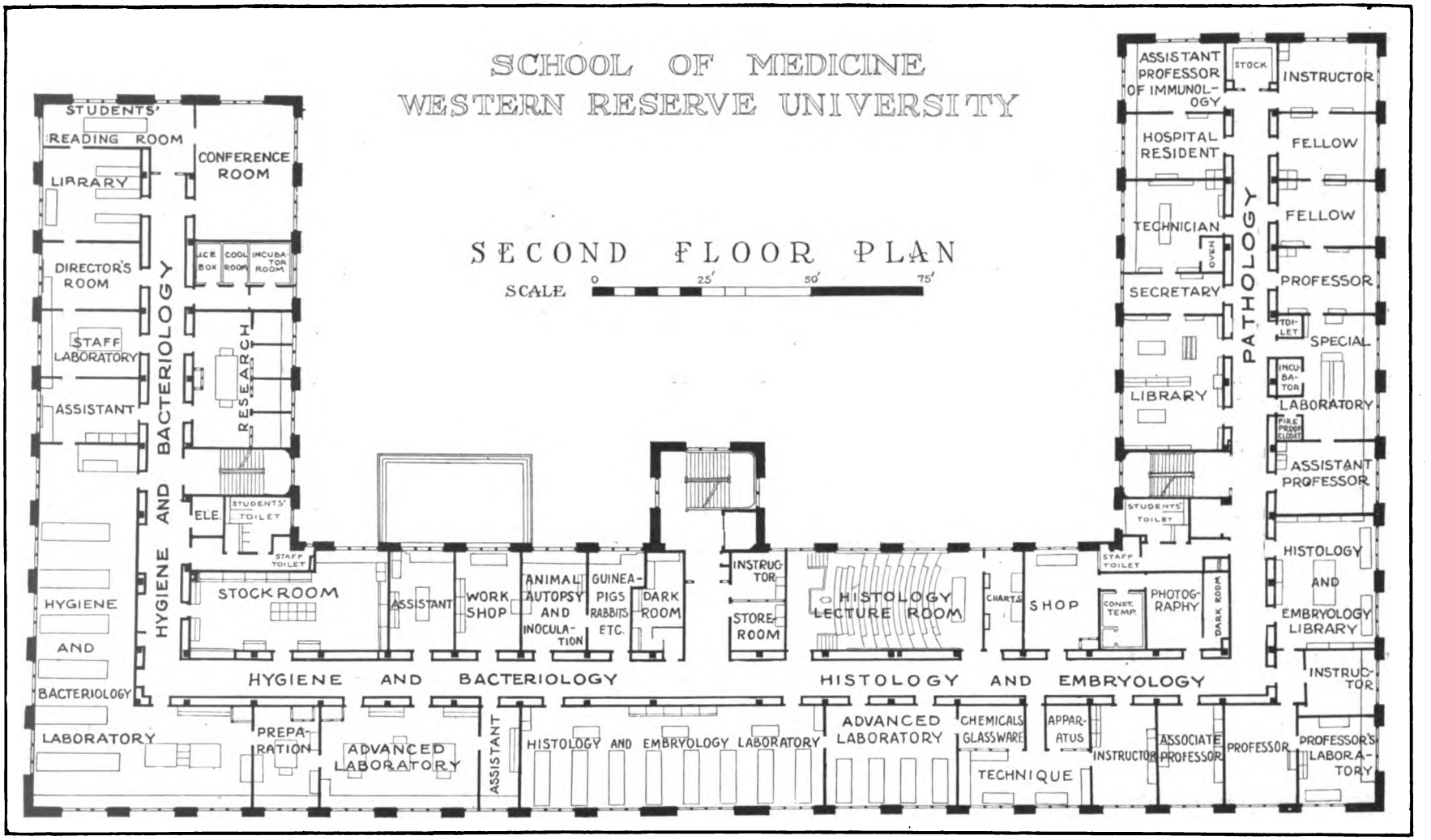

FIG. 4

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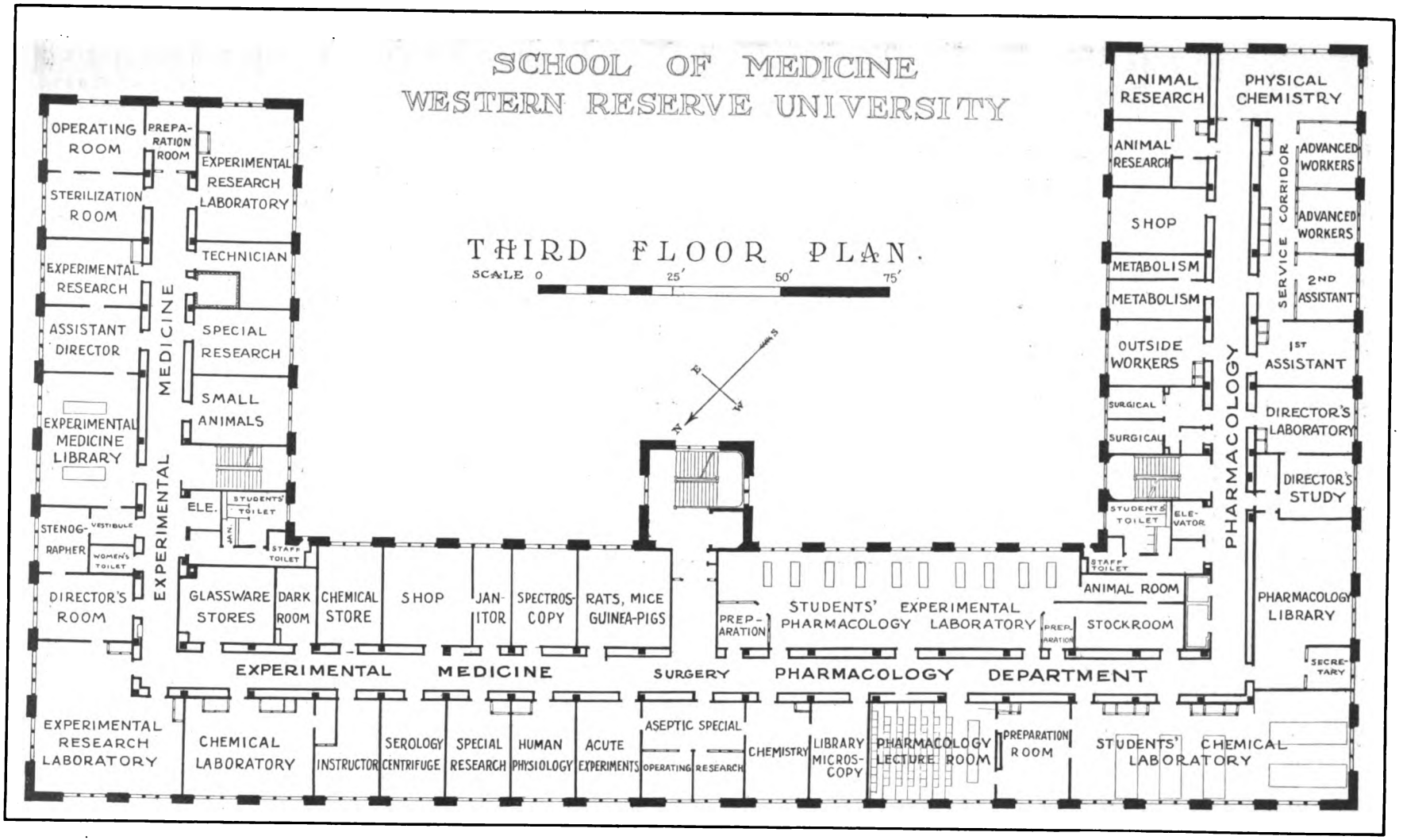

FIG. 5

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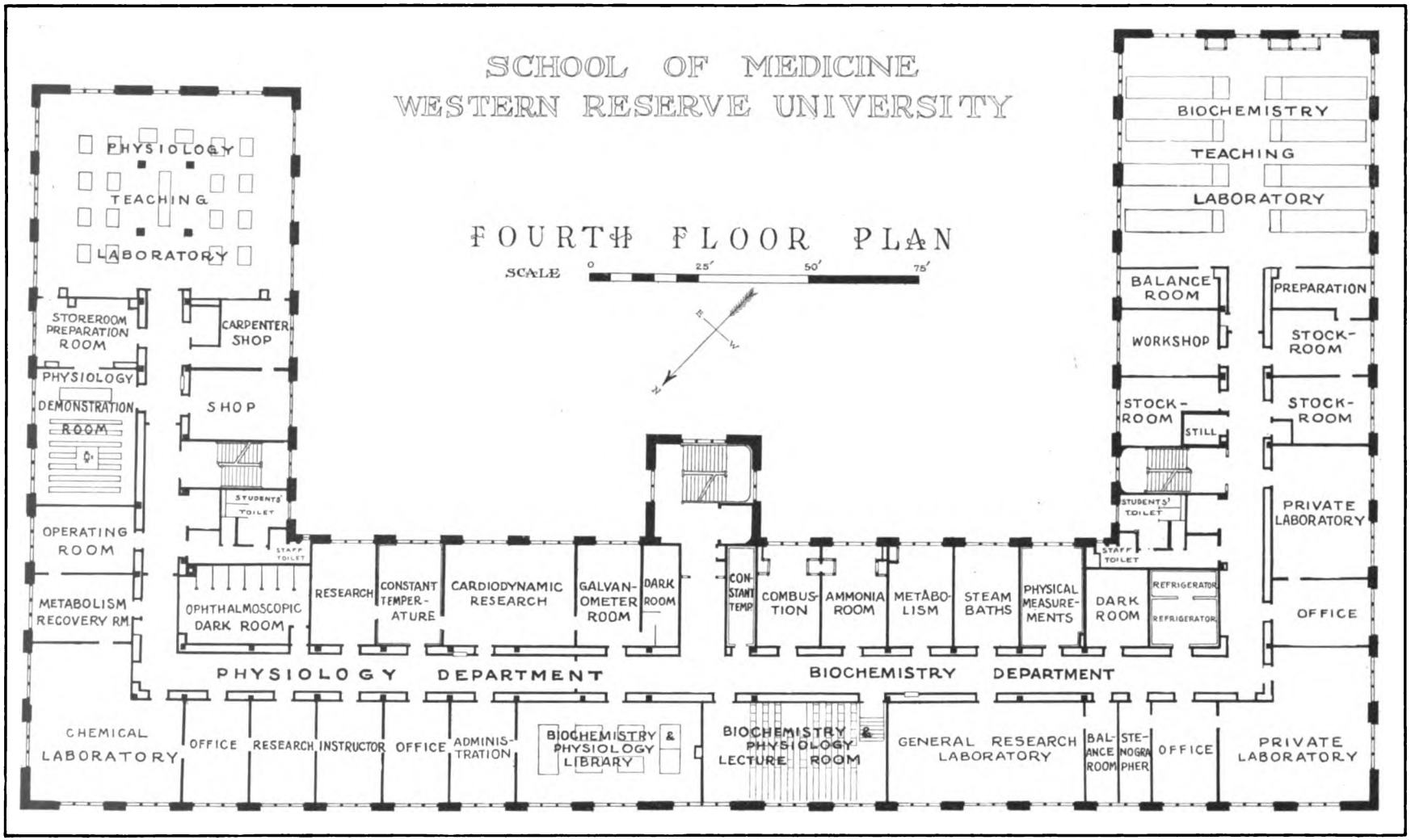

FIG. 6

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we often lose sight of the fact that we are not preparing specialists in the several sciences but doctors of medicine. Much is written and spoken as to the lack of correlation between laboratory and clinical subjects, the former often being regarded as "theoretical" training which is abruptly broken off to give way to the "practical" work of the hospitals and dispensaries. Fear is expressed lest the more extended training in the use of instruments of precision may dull the keen sense of accurate observation so important to the physician.

Without venturing an opinion as to conditions in other departments of a medical school, the writer is firmly convinced that such criticisms no longer apply to a modern department of physiology. Few of the fundamental sciences serve so admirably as a means of developing the really desirable traits, habits, and accomplishments of the great physician as does the subject of physiology. For these reasons, we at the Western Reserve University School of Medicine hold it to be our duty—not as physiologists but as medical educators—to do more than offer our students a background in physiology which is just sufficient for their needs in medicine.

Instruction in physiology begins in the last semester of the first year, following the introduction of students to the subjects of anatomy, histology, embryology, and biochemistry. In a total of ninety-six scheduled hours, of which approximately twenty-four are didactic, we aim to present physiology as an exact science. Its relation to physics and chemistry is emphasized. We seek to inculcate habits of exactness in experimentation, in recording data, in interpreting and evaluating results, and in drawing, but not overdrawing, conclusions. This work covers general physiology, the physiology of different types of muscle, nerve, and simple reflexes. At opportune intervals the students are introduced to experiments showing how the functions thus studied are probably determined by physicochemical forces.

The second year is scheduled for 224 hours of which about one half are didactic. The first purpose of this course is to give students an adequate grounding in the essential subjects of respiration, blood, circulation, secretion, digestion, metabolism, central nervous system, and special senses. Throughout this work the clinical aspects of physiology are placed in the foreground. The much stigmatized "frog-leg preparation" is entirely withdrawn during the second year, all experimental work being conducted on lower mammals or on man. Special emphasis is placed on such subjects as vital capacity, dyspnea, acidosis, cardiac arrhythmias, gastrointestinal phenomena, diet, diabetes, insulin, fever, etc. The importance of current investigative work in physiology and the necessity of keeping abreast of it throughout his medical career are constantly impressed upon the student, who is not only required to read current textbooks, but is assigned monographic presentations for reading and discussion. Presented in this manner, physiology instruction is neither more theoretical nor less practical for the student of medicine than any of his later clinical work.

In the actual performance of mammalian experiments on properly anesthetized animals and under constant supervision of competent instructors a second purpose is accomplished. The student is taught the physiological significance of anesthesia and is introduced to the interesting field of operative technic. To us it seems of real importance not only that the student should have an introduction to operative technic on living animals, but also that certain pernicious reflexes contracted in the dissecting room should be corrected, e.g., the tendency to skin animals, to grasp nerves with forceps, to pick around blood vessels with pointed instruments, etc. Further, he must appreciate the differences between living and dead tissue, must learn something of the relative viability of different organs, and must appreciate the fact that the most skilful technic is of no avail if an organ is functionally damaged or if surgical shock is allowed to develop. Can it be justly said that such experience is purely theoretical or that any clinical contacts that can possibly be provided for second-year medical students can be substituted for it?

In the thorough "working up" of experimental results, which is required outside of scheduled hours and discussed in conferences, a third purpose is accomplished. By carefully describing, interpreting, and discussing the physiological reactions obtained from men and animals, the cerebral processes involved in logical reasoning, so essential to diagnosis, are exercised and developed. No experiment is written up as demonstrating a given proposition. We strive rather to stress the essential similarity between the

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experiments that the student conducts in the laboratory and those which Nature chooses to perform on man, thereby creating disease. We continually emphasize the point that the signs and symptoms of disease are but results, effects, or manifestations of some experiment going on in the body, and that in order to interpret the nature of the derangement in function the student must become proficient in analyzing, evaluating, and interpreting the data presented. Does it matter whether this experience is gained in the laboratory or at the bedside? Is the development of such an attitude during a course in physiology an asset or a liability in future clinical work?

A final and often misunderstood purpose is accomplished in the training obtained in the use of instrumental methods. Our medical students record respiration, radial pulses, central pulses, and heart sounds. Each student is taught the technic of blood pressure determinations, is practiced in the principles of electrocardiography and understands the general significance of electrocardiograms. He uses a variety of gas analysis apparatus, determines alveolar CO_2, estimates pH changes under experimental conditions, conducts a complete metabolism experiment, and so on. The purpose of these refinements of observation and registration is always held before the student. They do not and are not intended to supplant the interpretation of simpler signs or symptoms but, on the contrary, make their significance clearer or give them a broader meaning.

In order to accomplish these multiple purposes of a physiology course, it is not only necessary that the department head carefully plan and organize every phase of the didactic scheme, it requires, above all, that the execution of the plan be placed in competent hands. Unless, however, a department contains a highly experienced staff, thoroughly conversant alike with the subject matter and with the methods for making the aims and objectives of the course effective, it becomes necessary for the department head to actively lead in the conduct of didactic work. This is an obligation he cannot conscientiously shirk even under the pressure of other duties.

The optional elective courses offered to medical students are: (1) a practical course in the principles and practice of electrocardiography, (2) advanced work in the science of nutrition, (3) advanced work in the study of acidosis, all given in the latter part of the second year; and, (4) lectures and demonstrations on the modern aspects of the circulation in disease, offered to senior students.

Research Policy

No modern physiology laboratory of a medical school can lay just claim to any considerable financial support nor consider its obligations to science or humanity fulfilled unless earnest efforts are made to contribute to physiological research. This not only requires adequate financial support and suitable facilities for research but also necessitates that members of the staff be afforded adequate time for such investigation. Obviously this can be accomplished in one of two ways, either (1) by maintaining separate research and teaching staffs, or (2) by so arranging the teaching duties that each member of the staff has sufficient time available for uninterrupted investigative work. The writer is firmly convinced that the latter policy should be encouraged as far as possible, for the duties of investigation and teaching can be combined with mutual advantage. The investigator, impressed with the actual difficulties encountered in making Nature reveal her secrets, is apt to be less dogmatic and more judicial in the presentation of the subject matter than is the pedagogue who places his faith entirely in the written text. The scientific investigator considers it a teacher's duty not only to tabularize knowledge in forms convenient for passing tests but he also seeks to inspire his classes with the spirit of inquisitiveness so essential to the future physician. His didactic efforts are not entirely concerned with an evaluation of answers to questions and the recording of appropriate grades, but are directed more largely to that greater task, the development of the faculty for applying and correlating assimilated knowledge. On the other hand, the contact with students, eager to discuss and anxious to question, gives new spirit to the investigative type of mind. The writer can personally attest to the fact that several of his best researches were inspired by issues raised during classroom conferences.

The plan of utilizing the entire staff both as instructors and investigators is now in force in the Physiology Department of the Western Reserve University Medical School. The work of each member of the staff, including the department head, is so planned that at least one half of the academic year is devoted exclusively to research and the remainder to teaching. In addition the laboratory is open during the summer months, thus enabling the regular staff to

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have more than half the calendar year for research work. During several summer months qualified medical students are also given an opportunity for research, for which time is not usually available in a crowded medical curriculum. A number of really important contributions have thus been completed by students in this laboratory.

The Training School Function

Work in the fundamental medical sciences must be self-perpetuating. No special schools exist for training the leaders of the future. Consequently, the modern physiology department must recognize that the training and development of junior men is no minor obligation.

It is generally recognized that, of the many junior men who hopefully enter upon a career in physiology, but few attain positions of rank and responsibility. While this is in part due to deflections to related sciences and to a yielding to the financial temptations of medical practice or commercial laboratories, the fact remains that far too many physiologists grow old in quite secondary positions. We cannot deny that the inherently limited capacity of some of these individuals is to blame, but the writer surmises that the failure of laboratories to supply proper training has been the cause of not a few of these non-promotions.

Though it is a sad commentary upon our laboratory policies, it has to be admitted that young men of promise have been tempted into the fundamental sciences by the hope of ultimate advancement to places of rank and importance, only to find that ambition ruthlessly sacrificed on the altar of departmental expediency. A new man is added to a staff; the teaching duties of the department are large; the young assistant, willing, obedient, and faithful to his chief, is loaded down with teaching duties so vast that no time for investigative work remains; or he is placed upon research problems and given, at most, cursory and undirected opportunities to assist in the didactic program. In neither case, unless he has unusual talent and energy, can he hope for promotion befitting his service. If he is alert and wise—and he usually is—he changes his field of endeavor; otherwise he must continue in an inferior position.

The training school function of a department requires (1) that opportunities to participate both in research and teaching activities be accorded to the junior members of the staff and (2) that both of these activities be wisely directed by the senior members. It is not sufficient to organize the work so that an instructor's performance in the classroom is satisfactory and his research productive from the scientific standpoint; it is imperative that both kinds of work be so correlated that the experience gained in them promotes the development of each individual member of the staff.

Neither the zeal and wisdom of a laboratory director, the capacity for development on the part of the younger men, nor liberal financial support will avail, however, if space and facilities are lacking. The inadequate accommodations of our old quarters have probably interfered more with this function of the laboratory than any other factor. Our new building, where space and facilities for every field of physiological activity are provided, should make it possible to develop more largely this training school function of the laboratory.

In accordance with the desire to afford training facilities for promising junior men, it is not our intention at this time to build up a staff that may be considered permanent. At present, the professor is the only member of what may be regarded as a permanent organization. It will undoubtedly be necessary to add an associate professor in the near future. As to the rest of the staff it will be our policy to retain a man only so long as he can still develop or until, because of outstanding development, he is naturally drafted to fill a position of rank and responsibility in another institution. Finally, no motive of mere laboratory expediency must tempt us to outbid other institutions when they offer to our men positions which it is clearly to their ultimate advantage to accept.

The training school function of a physiology laboratory, as we conceive it, must extend also to that type of man who eventually proposes to enter the field of clinical medicine or clinical surgery. Physiology has so definitely established her claim to be recognized with pathology as one of the basic sciences underlying clinical medicine and surgery that no one should now enter these fields without an apprenticeship of a year or two in a physiology laboratory. It is our aim always to encourage promising men who have such ambitions.

2. THE NEW PHYSIOLOGY LABORATORY

In designing new quarters for the Physiology Department every effort was made to improve our facilities for the better performance of the functions outlined above.

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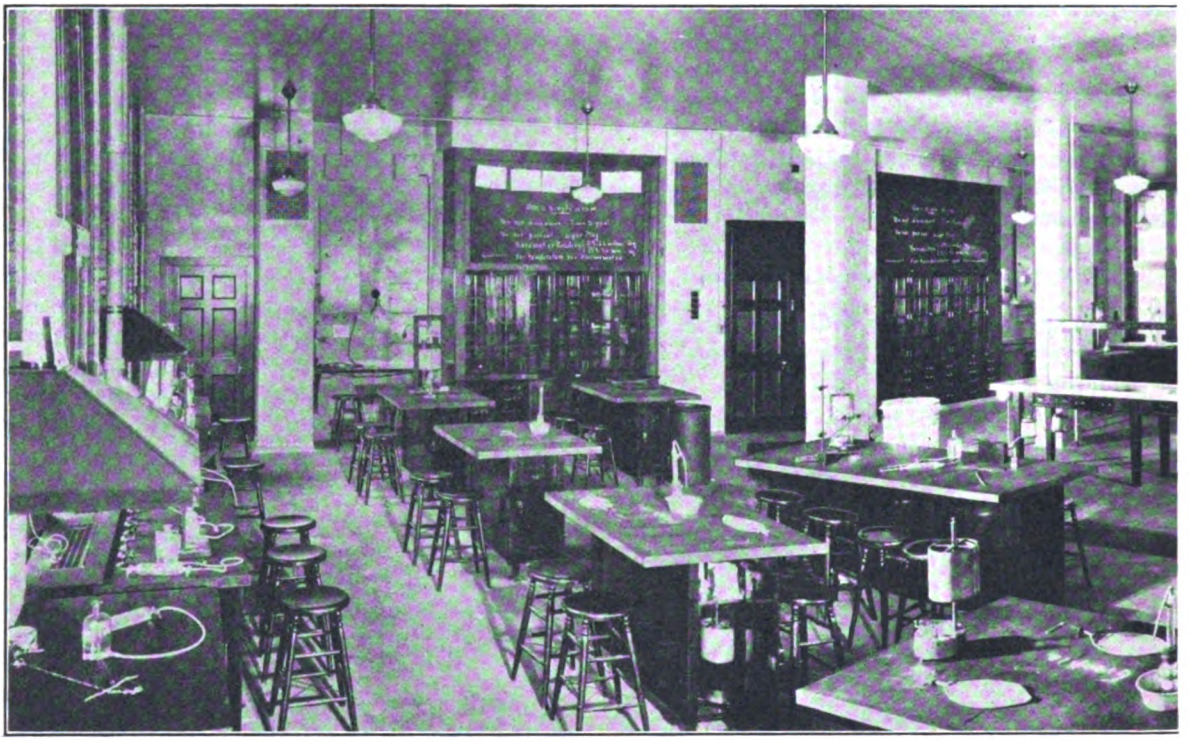

FIG. 7.—MAIN LABORATORY AS

The new medical building has the form of the letter E and consists of a main division with a frontage of 307 feet and two side wings, one 174 and the other 159 feet long. It comprises four floors, an attic, a basement, and a sub-basement connected by three fireproof staircases, and three automatic elevators. The sub-basement connects with the power house in the rear which furnishes steam, electric current, cold storage, compressed air, and vacuum. In the sub-basement is an incinerator for the destruction of animals, dissected material, etc. In the rear court between the wings is a building containing an animal house and a hospital, the former equipped with kennels and paddocks for housing supply animals and the latter with metal cages for hospitalization and storage of "survival animals."

The architectural plans of the medical building are worked out on a unit system of rooms arranged on either side of spacious corridors. Each unit has an exterior dimension of 15 feet, 10 feet of which is taken up by three large windows, a length of 24 feet, giving a net floor area of 320 square feet, and a height of 13 feet. A high degree of flexibility in adapting the system to the varying needs of different departments has resulted in creating quite an individualized appearance on the different floors.

The Department of Physiology occupies the eastern portion of the upper or fourth floor, i.e., the eastern half of the main front section and the entire east wing (Fig. 6). The total floor space[1] approximates 14,356 square feet of which roughly 4,500 square feet are assigned for student use, 7,936 square feet for research quarters, and 1,920 square feet for offices and corridors.

STUDENT FACILITIES

Under this caption are included (a) the main laboratory, (b) the optical dark room, (c) the library, and (d) demonstration and lecture room.

The student laboratory, situated at the extreme south side of the east wing, has an area of 2,464 square feet, and comprises six units plus the corridor space. As the maximum capacity will be eighty students, this allows over 30 square feet as the minimal working space per student.

The laboratory is well illuminated, even on dark days, by twenty-six large windows on three sides. In addition, two types of artificial light are available: (a) fifteen overhead reflecting lights, and (b) thirty-six desk lamps plugging into sockets in the floor. The laboratory is fitted

[1] Not including a joint physiology and biochemistry lecture room.

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ARRANGED FOR GROUP EXPERIMENTS

with table accommodations for seventy-two students (Fig. 7). Each table contains two lockers for apparatus and affords working space for four students. They are firmly built and practically free from vibration in spite of the fact that they are not fastened to the floor. The overhanging tops (Fig. 7) furnish leg room for the experimenters. Being movable, these tables may be systematically arranged for the simpler types of experimental work or they may be rearranged for special group experiments. Experiments in which excellent illumination, gas, water, air, or vacuum is required are performed on fixed wall-benches placed before the windows. Chemical work is restricted to small groups and is carried out in the chemical laboratory.

The flexibility of table arrangement makes the laboratory adaptable to different modes of instruction and varying plans of laboratory work, an advantage not only to the student but to the instructing staff as well. There is no greater deterrent to progressive instruction in physiology than a crystallized course, unchanging as the years roll on; nor is anything so conducive to keeping a course unaltered as the fixation of student furniture. The desired movability of furniture is attained by the elimination of belt and pulley-driven kymographs and the substitution of those propelled by clockwork. It may be added in passing that to the writer's mind this is an important consideration in equipping a laboratory. For, quite aside from the technical troubles certain to arise in belt and pulley systems, the fixation of tables violates an important didactic principle in the teaching of physiology. It tends to stereotype and standardize the experiments of all groups and inclines the students to follow blindly explicit directions for setting up experiments instead of inducing them to exercise their ingenuity and inherent talents. Finally, it wrongly focuses the attention on the kymograph as the center of the experimental method, whereas the kymograph should play an accessory function only.

Special apparatus such as gas analysis apparatus, spirometers, mercury blood pressure outfits, artificial circulation machines, and special sense apparatus, is accommodated in lockers arranged between the window benches on three sides, and on the north side as well (Fig. 7) where blackboards can be drawn from above. Four benches, two on each side, covered by ventilating hoods, furnish space for smoking of drums. A zinc-covered table containing four shellac pans and drying racks provides for the shellacking and drying of kymograph records.

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In the floor, which is of asphalt, are located in convenient places: (a) drains, (b) electric light plugs through which either storage battery or direct current can be supplied at each table, and (c) a cross-system of covered shallow trenches carrying signal wires, compressed air, etc., with outlets for each table group. These trenches also make possible future changes often so difficult to accomplish in new buildings beset as they are by the multiple restrictions of building codes.

Opening off the student laboratory on the east side is a stockroom for storing laboratory and demonstration apparatus in compact form. As this room communicates by large sliding doors with the demonstration room, preparation of demonstrations can also be made here. The laboratory and stockroom are in charge of a technical assistant who devotes practically his entire time to keeping the apparatus of the student laboratory in order.

Demonstrations are given approximately every two weeks in the demonstration room adjoining the stockroom and only a few steps away from the student laboratory. This room is provided with black pantasote shades, a Bausch & Lomb balopticon with screen and a system of artificial ceiling illumination controlled not only by a suitable switch but by a dimming rheostat. The lecture table is illuminated by a 1,000 c.p. daylight lamp which can be raised and lowered as desired. Ample space is provided over the entire south wall for blackboards and over these curtains for fastening charts can be drawn.

The demonstration table, having an area of 187 square feet, is equipped with gas, water, air, vacuum, electric power (110 v. D.C.), and storage battery current (2-25 volts), and contains reasonable locker and drawer space for the storage of demonstration apparatus. The middle section is movable and may be rolled directly into the demonstration room through large sliding doors. Rows of student benches rise on concrete steps, guarded in front by iron railings. During the observational intervals of an experiment, students are expected to stand, the wooden benches serving only as a rest at uninteresting moments.

Regular lectures and recitations are held in a similar but somewhat larger room in the biochemistry wing. This covers an area of 900 square feet and has seating capacity for eighty students. The arrangement, equipment, illumination, projection, etc., are similar to those of the demonstration room, except that the demonstration table and blackboard are larger and that the hall is provided with comfortable seats with writing arms.

It is obvious from the description that the plans are designed for relatively small classes, which makes it possible to correlate laboratory and other didactic work and does not necessitate repetition of work during any part of the school year.

Experiments involving photographic development as well as ophthalmoscopic observations and optical experiments are carried out by small groups of students in an optical dark room. This room, which is 29 feet long and 16½ feet wide, is provided with all the bench facilities of a chemical laboratory and with the customary dark appliances and equipment. The room is well ventilated and closed by double doors opening into the corridor. It contains a row of seven stalls equipped with adjustable light brackets for individual ophthalmoscopic training. The roof of the stalls furnishes a balcony for storage of bulky apparatus. As this room is required for teaching purposes during only a relatively small part of the school year, it will also be utilized for research work of an optical nature, photography, etc.

The Library

The School of Medicine at Western Reserve University is committed to what may be styled a modified plan of departmental libraries, that is, each department maintains a library of such literature as most immediately concerns its fields of activities. It is understood, however, that generous privileges in the use of its books and periodicals are granted to all who hold positions in the medical school. In this way the advantages of a central library are in effect combined with the very obvious advantages of a departmental system. This, it may be added, is accomplished with no greater duplication of books and periodicals than seems necessary.

For many reasons it has seemed wise in the case of the departments of biochemistry and physiology to develop a combined library. The library room shown in Fig. 8 is 42 by 22 feet and covers an area of 924 square feet. Around the four walls are placed twenty-eight bookcases with sliding doors, capable of holding about three thousand bound volumes, and three specially designed cases capable of storing in separate dustproof compartments the files of 120 current periodicals. In the center are eight solid tables 3 x 6 feet in size, with thirty-six comfortable chairs. The room is well illuminated both by artificial

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and natural light. The library contains about two thousand volumes mostly in the form of complete sets of the more important physiological and biochemical periodicals. Facilities for reference work are excellent, including the physiological section of the Concilium Bibliographicum in card index form and such reference works as the Quarterly Cumulative Index to Current Medical Literature, Zeitschrift für die gesamte Physiologie, Jahresberichte über die gesamte Physiologie, Berichte der Physiologie, Zentralblatt für Physiologie, Chemical Abstracts, Physiological Abstracts, and Physiological Reviews.

The essential purpose of the library is to place the proper reference books and periodicals at the immediate disposal of investigators. It is considered important that articles should be available when and where they are needed by the staff. Reference books are placed at the disposal of students only by special permission and when special reading assignments are made for reports. The amount of reference work which the average medical student can carry on with an already overloaded curriculum is necessarily small. In our opinion it is far better for the student to devote his available time to the perusal of the many excellent monographs and reviews than to attempt the reading of original articles, often in foreign languages which he has not mastered. To encourage this type of reading, such books are placed on special shelves to which students have unrestricted access and from which they may borrow books overnight and during holidays.

FIG. 8.—LIBRARY, DEPARTMENTS OF PHYSIOLOGY AND BIOCHEMISTRY

RESEARCH FACILITIES

Every department of physiology, either by design or by accident, tends to develop one field of investigation more than others. It is but natural that the dominant trend of researches in progress at the time a new building is being erected should be mirrored in the research facilities provided. Care must be exercised, therefore, that other forms of investigative work can be not only accommodated but that they can be developed into dominant types of research as department heads or policies change. These principles have been kept clearly in view in designing the new quarters of the Physiology Department. Fortunately the writer had the benefit of plans already made by his predecessor, Professor Macleod, which had distinct leanings toward other fields of investigation. In planning the research quarters an effort has been made

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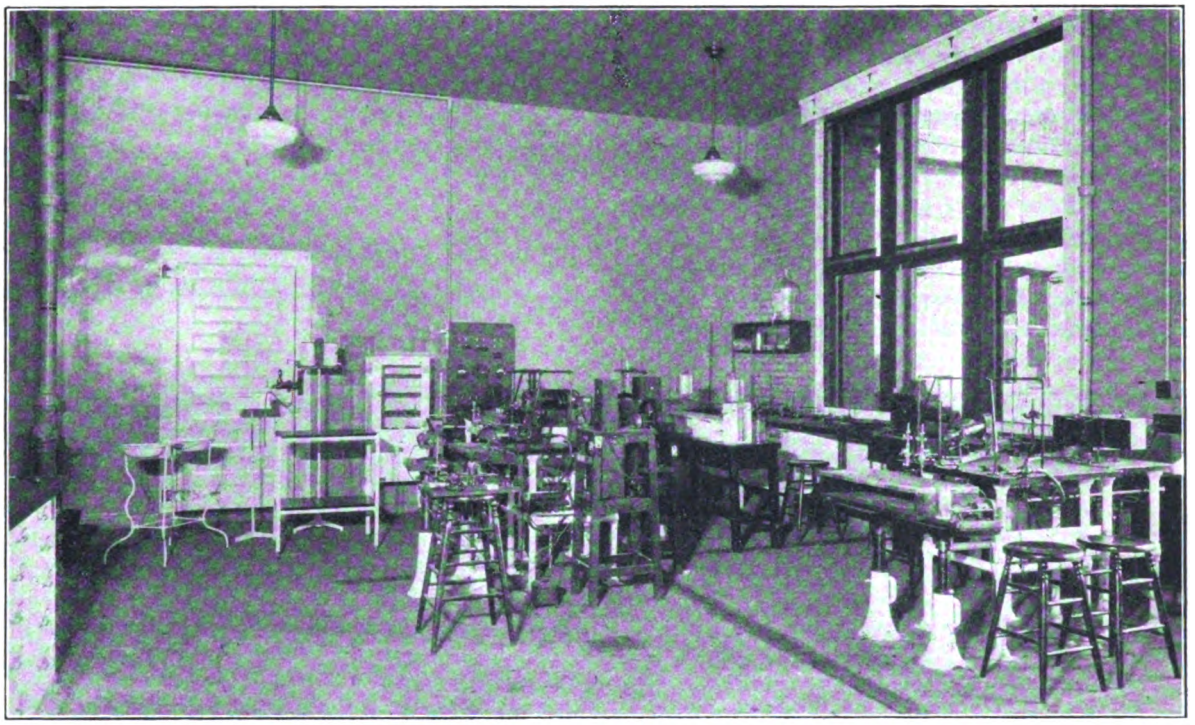

FIG. 9.—CORNER OF LABORATORY FOR CARDIOVASCULAR RESEARCHES

to provide the best accommodations and the most complete equipment for the study of cardiovascular problems by optical methods of registration. Indeed, we have striven to make this laboratory the best equipped of its kind. The laboratory for cardiovascular researches (see Fig. 9) comprises a suite of three rooms, one (29 by 22 feet) for animal investigations, another (14 by 22 feet) for researches on man, and a dark room (8 by 22 feet). The woodwork and apparatus supports are finished in white, in contrast with the table tops, which are finished in black. The rooms may be transformed from well-lighted to dark rooms by drawing the black pantasote shades.

This laboratory is fully equipped with a large variety of apparatus for cardiodynamic study, much of which is of special design. Among the optically recording apparatus we find different patterns of optical manometers, segment capsules, heart sound recorders, sphygmographs, myocardiographs, cardiometers, etc. Several forms of stimulators for applying induction shocks at varying rates and at different intervals of the cardiac cycle are available, also six projection lamps, five photokymographs, and several types of optical time recorders.

To use such apparatus in a practical way two complete sets of supplementary apparatus are installed (Fig. 9), each consisting of (a) a photokymograph with 12 cm. paper, (b) a time recorder projection, (c) a regularly fixed table for mounting optical lamps and apparatus, (d) solid but adjustable animal boards, and (e) specially designed artificial respiration apparatus. One of these outfits is also aligned with a Hindle string galvanometer, thus permitting coincident registration of dynamic and electrical phenomena. By placing a third photokymograph directly in line with the galvanometer, the latter may be used separately. Two movable long paper kymographs with mean blood pressure apparatus are also provided for supplementary registration. Benches for preparing instruments for experiments are placed at the walls and in front of one set of windows. These are equipped with taps for water, gas, air, and vacuum. The rooms contain a system of shallow trenches, similar to those of the student laboratory, which communicate also with the entire south tier of rooms. Through a specially designed cabinet electro-cardiographic connections can also be made with other departments of the school and with the hospitals as well. Currents, both 110 voltage direct and 2 to 25 voltage storage battery, are controlled through a main switchboard. The room devoted to investigative work on man contains a Cambridge string galvanometer,

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equipped with double strings, heart sound recorders, segment capsule outfits, and other apparatus for graphically recording circulatory phenomena. Use is also made of this room for instruction in electrocardiography to small groups of students.

As already indicated, provision for other types of investigative work has not been neglected. Adjoining the laboratory for cardiovascular research is a constant temperature room. The walls, floor, and ceiling of this room are insulated by cork and air spaces, the windows are double and the doors are of a large refrigerator type. The air of the room is cooled by brine coils arranged below the ceiling and again warmed to a constant temperature by a thermostatic steam control. This room is especially adapted for work involving great accuracy, such as calorimeter work, physical measurements, gas analysis, etc. It contains a small respiration chamber, a Tissot spirometer, various forms of gas analysis apparatus, a Leeds and Northrup hydrogen ion apparatus, etc. In addition, it is reasonably sound proof, thus lending itself admirably to studies of sounds as well as to psychological and reflex experiments. Communicating with this room is another unit for similar work not requiring constant temperature regulation. Two rooms are reserved for other special fields of investigative work and are so arranged that they can be used for different purposes. For the present they will be used for researches in general physiology. Chemical phases of research work are centered in a large well-lighted chemical laboratory encompassing an area of 1,216 square feet. This laboratory contains window benches, sinks, cupboards, shelves, etc., for general chemical work and a fully equipped central bench on which work space can be assigned to individual workers. It contains two hoods, two steam baths, two Kjeldahl digestion and distillation racks, centrifuge, balances, etc.

One unit of 320 square feet is designed for an operating room. It is closed by double doors, is finished in white enamel, and contains a full operating room equipment for experimental work requiring aseptic surgery. This room connects with an animal preparation and animal storage room of 320 square feet, which is furnished with a bath tub, three animal cages on a shelf, four frog tanks of alberene. Two units, containing an area of 640 square feet, are reserved as a shop where two mechanics are employed. The shop proper is equipped with lathe, milling machine, shaper or planer, and drill press, each driven by its own motor, thus eliminating shafting and countershafting. Additional mechanical apparatus is being added. The adjoining room is largely devoted to woodwork, containing carpenter's bench, rotary saw, etc.

Only three units of the entire space assigned to the department are reserved for offices, our aim being to reduce to a minimum what Cremer has designated "graphite and cellulose" research. With the exception of the department head and two senior members, desk space for the staff is provided in the rooms in which their investigations are carried on. One unit, which is reserved for departmental administration and occupied by the departmental secretary, contains a variety of filing devices for charts, correspondence, administrative matters, reprints, lantern slides, optical and smoked tracings, library index cards, stock supplies of stationery, etc. It serves also as a reception or ante-room to the professor's office which comprises an adjoining unit.

Additional storage space is available in the basement and one room in the animal hospital is assigned to the department for survival animals.

COMPOSITION OF PRESENT STAFF

All members of the professional staff give their whole time to teaching and research. Following is a list of the members of the professional staff at the present time:

Professor of Physiology, Carl J. Wiggers, M.D.; Senior Instructor, George B. Ray, B.S., A.M., Ph.D.; Senior Instructor, David Rapport, A.B., M.D.; Demonstrator, M. Garcia Banus, B.A., M.Sc., Sc.D.; Fellow, Stanley R. Burlage, Ph.D.; Crile Research Fellow, Arthur C. De Graff, B.S., M.D.; National Research Fellow, M. Jane Sands, A.B., M.D., Sc.D.

The technical staff in the immediate employ of the department consists of: (a) a technical assistant, who is both a competent mechanic and a skilful assistant in operative cardiodynamic work; (b) a technician who is in charge of the student laboratory apparatus and offers technical assistance to laboratory investigators; (c) a mechanic employed in making and repairing physiological apparatus, and (d) a departmental secretary and librarian. Animals are cared for by an animal keeper in charge of the animal house. Cleaning, janitor service, repairs, and extensive work in plumbing, steam, and electricity are under a separate house organization.

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WESTERN RESERVE UNIVERSITY SCHOOL OF MEDICINE DEPARTMENT OF PHARMACOLOGY

BY

TORALD SOLLMANN, M.D.

PROFESSOR OF PHARMACOLOGY AND MATERIA MEDICA

The new quarters provided for the Department of Pharmacology of the Western Reserve University School of Medicine through the idealistic generosity of Mr. Samuel Mather are the embodiment of certain conceptions of the development of pharmacology, both as to teaching and as to research, which represent an attempt to adapt the experience gained with various methods to the changing conditions of this Department and of pharmacology and medical education in general. As these conceptions and points of view guided the material construction, a somewhat full exposition of them may be excused, we hope, especially as their applicability does not appear restricted to this Department.

I. THE PLACE OF PHARMACOLOGY IN MEDICAL TEACHING

There is no one method of teaching an active, living, developing subject. The author has used many methods, at different times, and hopes to use more. The general purpose and trend of these changes has been to help the students to obtain an understanding of pharmacology as a tool, and to show them how to make use of it in their present and future problems, rather than to treat it as an independent subject to be mastered for its own sake or in order to pass an examination.

There still prevails all too widely a popular misconception of pharmacology as a somewhat rejuvenated or made-over "materia medica", consisting mainly of the painful acquisition of useless facts or misinformation, which has little place in modern medicine. This is not a very just estimate even of the old-time materia medica which, like all sciences in their infancy, no doubt did the best it could under difficult circumstances. In any case, it has long since ceased to be applicable to modern pharmacology, which is the offspring of a union of traditional materia medica with science. This may perpetuate some of the character traits of its ancestry, but it has individual traits of its own, and one of these is a very much wider outlook and a much broader conception of its functions. Its sphere of activity, as reflected by titles in the journals and transactions, covers that aspect of biology which deals with the reactions of living structures to the chemical and physicochemical changes of their environment—a far from narrow aspect. In a sense, physiology may be conceived of as one expression of an environment, pathology as a wider and more varied expression, and pharmacology as a still more varied expression. Of course any subject can be interpreted so broadly as to engulf all the related subjects. For practical reasons, however, it is necessary to establish, not boundaries as is sometimes said, but foci of interest. The important point is that modern pharmacology has recognized the fact that its lines of interest radiate through all biology, and *a fortiori* through all medicine; and that this point of view—the response of life to chemical changes of environment—is a useful and essential one, not only to its focus, pharmacology, but to the whole field of biology, and to all the other foci of interest that are or that may be established in that field. Considered in this way, pharmacology serves as a cement that connects and consolidates the various divisions of biology. But it is not unique in this respect. Each of the fundamental biological sciences, anatomy, biochemistry, physiology, and pathology may perform a similar function. In fact, any conception of biology is incomplete to the extent that each of these divisions fails to cement the others. Since its inception modern pharmacology has under-

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stood the need for this interradiation. Indeed it has sometimes sacrificed intensity at its focus to this broader conception of its function, in the belief that its point of view—the emphasis on the chemical factors of environment—required diffusion; and doubtless, too, because the very breadth of its conception tempts it to roam at large. The proper balance between the centripetal and centrifugal forces, in such a case, is a matter that only the retrospective wisdom of history can presume to judge impersonally; and about which there is meanwhile, and fortunately, opportunity for fructifying differences of opinion.

The position of pharmacology in the medical curriculum, toward the end of the laboratory subjects and the beginning of the clinical subjects, is especially advantageous to its cementing function. At this time the student, as a rule, still looks upon the sciences he has studied as distinct subjects—altogether too distinct; he has not yet succeeded in amalgamating them into a coherent whole. The clinical subjects appear to him as a world of a quite different order. The hiatus between the clinical and the fundamental subjects has been especially felt and recognized, and various artificial means of correlation have been proposed, but they all tend to fail in proportion as they are mechanical and artificial. The simplest and by far the most effective means of correlation is for each teacher to be broad-minded enough genuinely to conceive of his subject as a focus and not as a "field", and modest enough to consider it as a means to, and not as the end of, medical education. If he combines this breadth and modesty with a little good judgment, the desired correlation of the subjects; or, rather, the desired orientation of the student will follow of itself, so far as the mind of each student permits. Opportunities for this synthetizing influence exist in every subject, but not to the same degree. They appear especially rich in pharmacology, both because of its position in the curriculum, as already pointed out, and because of its contents, which blend very obviously with those of the other fields. It articulates with biochemistry, in that both deal with chemical changes, the one emphasizing the changes in the chemical substances, the other the changes in the living protoplasm; with physiology, in that pharmacology aims to explain the normal functions in terms of chemical reactions; with pathology, in that pharmacological reactions are pathological processes; with bacteriology and immunology, because the chemical reactions involved in these are strictly pharmacological; with all the clinical branches and especially with medicine, in that pharmacology aims to produce and to remove disease processes by the most important route, i.e., by chemical reactions.

These indirect functions of pharmacology have been considered first, because they seemed most in need of emphasis and because they are so often overlooked entirely when the usefulness of pharmacology is under discussion, or are brushed aside as insignificant by-products. To the writer they seem altogether too important to be neglected, for neglect or contempt is bound to lead to diminished emphasis on these points of view, to loss of enthusiasm, and to the sacrifice of opportunities that modern medical education can ill afford to spare. The wise use of by-products is even more important in education than it is in industry.

It would be most unfortunate, however, if this emphasis on the correlative by-products were permitted to overshadow the importance of the more direct and practical function of pharmacology, i.e., the understanding of the correct use of drugs. The support of pharmacology has doubtless been somewhat weakened by the rather shallow generalization that the use of drugs has a vanishing if not already vanished importance in medicine, since faith in our ancestors' somewhat childlike belief in "an herb for every ill" has been destroyed. The error in this deduction lies in the confusion of quantity and quality. Physicians may use medicines less, but patients receive immeasurably more benefit from the medicines used than they ever did; and they will receive more and more benefit, in proportion as the genuine value and the genuine limitations of drugs, both old and new, become better understood. The critical sorting of these data is the special function and special achievement of pharmacology. Fewer drugs are used than formerly, but the need for these few increases day by day. If drugs were eliminated from the world today, surgery would be reduced tomorrow almost to the level of medieval barber-practice, and internal medicine would be relatively helpless. It is not even certain that all the discarded drugs are useless; the occasional rescue from the rubbish-heap of a very useful tool, like chenopodium oil or quinidine, gives food for thought. In fact, the reduction in the number of drugs has been effected largely because attention has properly been concentrated on those of most promise.

The teaching of pharmacology has been responsive to this lead. It has placed more and more emphasis on a thorough understanding of the

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FIG. 1.—MAIN ENTRANCE

most important drugs, and has devoted less and less time to the drugs of doubtful utility. A certain limited amount of the old lore may well be discussed in the proper manner; modern physicians should understand something about what their fathers did and wrote, and about what some of their colleagues write and do. A picture cannot be true without perspective. A science should aim to train its students to look backward as well as forward.

The teaching of a sort of pseudopharmacology has also sometimes been perpetuated by the incubus of the supposed benightedness of state-board examiners. The writer believes that this fear is greatly exaggerated, and has long since ceased to pay attention to it; and he has not had occasion to regret his confidence in the fundamental good sense and good intentions of state examiners. A student might easily miss some of the questions on an unimportant drug, but if his answers show that he has a sound knowledge of those that are important, he may confidently expect to pass. The matter is of course facilitated by the agreement of many state boards to restrict themselves to the list in the "Useful Drugs" of the American Medical Association. This doubtless encourages the student to concentrate his energies on what is most worth while.

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II. UNDERGRADUATE COURSES AND METHODS OF INSTRUCTION

The practical value of any knowledge depends upon the ability to use it, i.e., to apply it to the solution of other problems. This again depends on the number of connections that have been formed with it in the brain. The greater the number of angles from which the subject has been seen and studied, the better will it be understood, remembered, and applied. A subject that is studied "once and for all" is apt to be locked away in a separate compartment of the mind, which is too unhandy to unlock, and if it is not actually forgotten there, at least its usability becomes so unfamiliar that it might almost as well be forgotten. Repeated use of a subject is the best training in its use. Probably every study would profit by being approached from several angles, thus combining repetition of facts with novelty of points of view—the familiar object in novel surroundings. The principle of multiple approach is especially important, however, for subjects which include not only logically deducible principles but also numerous disconnected details. This difficulty still inheres in pharmacology. A single survey is bound to leave a hazy picture, a confused impression of unpredictable and apparently unreasonable drug-phenomena, that could only be unraveled by the vigorous application of mechanical memorizing.

Instead, therefore, of taking up one drug after another in alphabetical or any other order, the writer prefers to present pharmacology from several points of view in a series of successive courses, each with distinct cultural objectives which have been correlated with the other portions of the pharmacology course, and which have also been rather carefully adapted to the development of the student in other parts of the curriculum. The first of these divisions deals with pharmacology chiefly from the standpoint of chemistry; the second from the standpoint of tissues, organs, and functions; the third from the standpoint of drugs; and the fourth from the standpoint of disease. These courses and their special objectives and methods will be discussed in the next section. It is important to

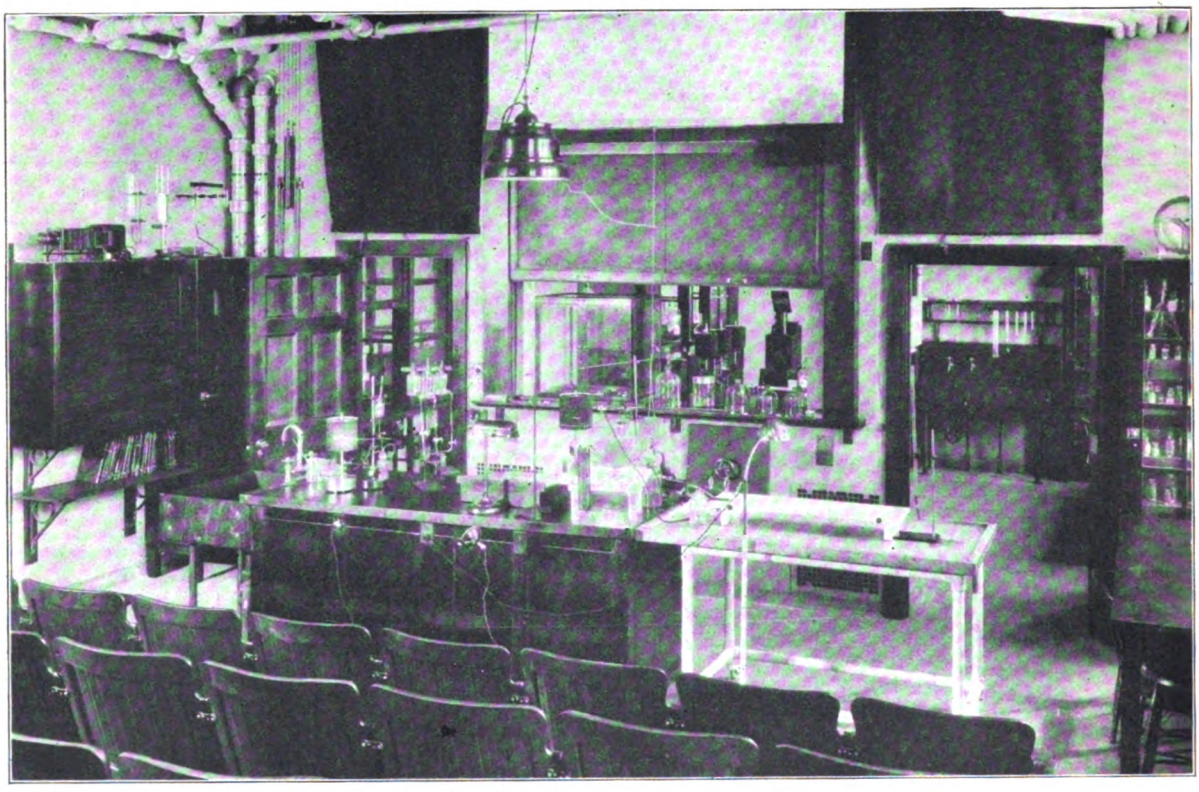

FIG. 2.—LECTURE ROOM, WITH VIEW INTO PREPARATION ROOM

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realize, however, that these courses are really only divisions; or, rather, that they are merely aspects of the same subject. This is emphasized by the fact that the final examination covers the entire subject (except the course on therapeutics).

Various methods of teaching are used in the different parts of the course. These have been worked out experimentally, by planning, and by trial and error. For a number of years the students were asked at the end of each course to appoint a committee to discuss with the writer the features and methods of the course. When the students found that they were taking part in a bona-fide study of teaching methods, and that their comments and suggestions received not only polite attention but active trial, the results of the conferences became very instructive and led to some interesting experiments in the technic of teaching and especially to the selection of the best from several tentative methods. Such suggestions naturally require the interpretation of experience. Some of the points suggested are evidently good at first sight, others require trial; while others concern methods that are not feasible or that have already been tried and abandoned. In the latter case a frank explanation is readily accepted. One point that especially impressed the writer was the frequent failure of the students to understand aims and objectives that he had failed to explain or had merely mentioned in passing, because they had seemed self evident to him on account of his long familiarity with them. But to the students, with their different environment, they were naturally not so self evident. The experience taught him to give much more attention to explaining the general objectives of the courses carefully and repeatedly; and he feels that better collaboration has resulted. Among the fundamental ideas that are made clear to the students are the general objects of the course, along the lines discussed in this paper; and particularly the fact that the course is not a drill in acquiring certain data, but an opportunity to learn; that it aims to arouse and to maintain the interest of the students, to stimulate and to satisfy their curiosity, and to leave as free a scope as practicable to their individuality and their choice of ways and means. It is impressed on the students that it is their task to "learn" the subject, and that it is the object of the instruction to guide them and to help them in this. Every opportunity is taken to cultivate a feeling of freedom and personal responsibility. There is no obtrusive checking of the daily work, but emphasis is laid on the final result. No grades are given on the daily work, but the conference method shows to the student where he and others are lacking; and such deficiencies are firmly pointed out as they occur. The work of each bimester is checked by a "test", written or oral; and the written tests are analyzed in considerable detail, with commendation or otherwise. These count toward the final grade, but their main object is to ascertain the general progress of the students so that they and the instructor may discover the causes of any weakness, either in the students or in the instruction.

III. DESCRIPTION OF COURSES

The methods of the individual courses, which will now be described, have been worked out for classes that would not exceed sixty students. This seems to be about the largest number with which the instructor can keep up the tutorial atmosphere which is the basis of these methods. Considerable modifications would doubtless be necessary for larger classes. The writer would, however, prefer to reduce the classes to sections of this limit with corresponding increases of the staff.

Course 1. *Chemical Pharmacology.*—This is a laboratory course of forty-eight hours in the second bimester of the second year, two one-hour and two two-hour periods per week. It has several objectives: it serves partly to illustrate and to emphasize the chemical relations of pharmacology, and partly to dispose of several subjects and aspects of pharmacology that are preparatory to the later courses. The instruction is predominantly by individual laboratory work, preceded if necessary by explanatory talks, and followed by conferences in which the results and assigned reading are discussed and expanded. A few of the topics are covered or aided by demonstrations. Emphasis is laid on observation, on correlation, and on the application of the information and data.

The following subjects are included in the course:

1. Chemical characteristics of the groups of active plant constituents, three hours.

2. Pharmaceutic manufacturing and dispensing methods, eight hours.

3. Principles of prescription writing, including also metrology, incompatibility, and flavoring. (Practice in prescription writing is continued through all the courses, partly in class and partly by home assignments.) Seven hours.

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4. Tests for poisonous drugs, general toxicology, absorption and excretion of drugs by man, eight hours.

5. Physicochemical phenomena in pharmacology, six hours.

6. Pharmacological reactions of blood and ferments, corrosives and irritants, antiseptics and anthelmintics, ten hours.

7. Conditions influencing drug action, four hours.

This course is given just before the course in experimental pharmacodynamics, and serves as an introduction to the latter. It begins when biochemistry has been laid aside for half a year, and so helps to restore the chemical background.

Course 2. Experimental Pharmacodynamics.—This is a demonstration and experimental course of eighty hours in the second semester of the second year, three one-hour and one two-hour periods per week. It deals with the reactions of tissues, organs, and functions to pharmacologic agents, emphasizing the relation of pharmacology to physiology on the one hand, to pathology on the other. The course begins when the students have just completed their physiology courses and two thirds of their systematic pathology; and the immediate object is to show to the student how the organs, which he has studied in health and in disease, behave under the influence of chemical changes, i.e., of drugs and of poisons, and then to help him to make critical deductions and proper applications of these data. The subjects are therefore arranged in the order of the organs, not of the drugs. This order is as follows:

1. Excitability: nerve fibers; local anesthesia, four hours.

2. Contractility: protoplasm and striped muscle, eight hours.

3. Smooth muscle tone: blood-vessels, iris, uterus, five hours.

4. Smooth muscle rhythm and peristalsis, five hours.

5. Cardiac muscle and nerves (cold-blooded), seven hours.

6. Bronchial, anaphylactoid, and glandular reactions; irritative phenomena and edemas, ten hours.

7. Cerebral depression and general anesthesia, ten hours.

8. Convulsions, three hours.

9. Respiratory reactions and heat regulation, eight hours.

10. Circulatory correlatives, nine hours.

11. Urine formation, six hours.

An important advantage of this arrangement "by systems" over the arrangement "by drugs" is that it articulates more naturally with the order to which the student has become accustomed in the physiology course, and therefore utilizes his acquaintance with that subject to the best advantage. Its chief advantage, however, is the avoidance of the seemingly endless repetition of very similar experiments with different drugs. Such repetition is not only tedious but confusing; relations and contrasts are better appreciated when they are brought together at one sitting, than when they are dragged out over many periods. The arrangement does not give a connected picture of the various actions of any single drug, but that would also be confusing rather than helpful at this stage; it is provided later on, in courses 3 and 4.

This general principle of presentation has been followed for many years, with only minor modifications; but considerable changes have gradually been introduced into the method. Originally all experiments were performed by students, arranged in groups of from three to six men, the groups being often assigned to different but related experiments, so that a field of sufficient extent could be covered in the time available. The results of the different groups were then collated, reported, and discussed in conferences; and the experiments were sufficiently related so that each student might be expected to be able to follow the work done by the other groups. This arrangement gave the students considerable experience with drugs and with experimental technic; but it had the major fault that the technical preparation of the experiments took so much time, especially the more complicated experiments with the less-skilled students and with the occurrence of the usual share of accidents, that little time remained for the observations of the drug-effects. These were often made so hastily and faultily that the main purpose of the experiment was spoiled; and in such cases considerable time and energy were needed for the demonstration of typical results to wipe out the erroneous impressions. In fact, considerable confusion between type results, abnormal results, and faulty results was difficult to avoid. There is in this respect a very important difference between laboratory courses in physiology and pharmacology; for the pharmacologic observations only begin where the physiologic leave off.

Two methods of correcting this difficulty of technic were tried, side by side. One, the preparation of the experiments by the staff, in advance

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of the class, so that the students could start at once with the observation of the drugs; the other, the demonstration of the more time-consuming experiments. The "set-up experiment" method does correct the difficulty considerably, and has been retained for all the work performed individually by students. It was soon realized, however, that in many cases it had not enough advantage over the direct demonstration to justify the cost in time and in materials, the latter being a not unimportant point in the supply of dogs. The individual experiments are distinctly preferable and in fact indispensable, when observations are to be made at close range, as in testing local anesthesia; or where the variability of the phenomena according to the technic is itself important, as with general anesthesia; and, in general, whenever the student has not already had sufficient personal experience with a similar technic, for instance, on excised mammalian tissues and on peristalsis. For such special cases, where a distinct and adequate benefit is secured by the personal performance of the experiments, this is retained in the course. The proportion of such work would vary with local conditions.

The experiment of introducing demonstrations was tried on a very limited scale, with some misgivings that it might lead to too passive or listless an attitude on the part of the students. It soon became apparent, however, that the actual result of the demonstrations, when well arranged, well conducted, and well explained, is just the opposite; that they arouse more interest, and that the effect on the students at this period of their training is on the whole distinctly better than that of crowded individual work. The advantage lies in the possibility of a clear, logical presentation of the experimental problems; in the illustration of fairly reliable and typical effects instead of unreliable and often misleading results; in the possibility of interpreting the phenomena when they occur and when all the conditions can be appraised, a matter of especial importance for complicated and unusual results; in the possibility of concentrating the entire attention of the student on the problems without the distraction of technic; and, finally, in the possibility of presenting adequately, intelligibly, and connectedly a much greater variety of phenomena in a given amount of time—also a matter

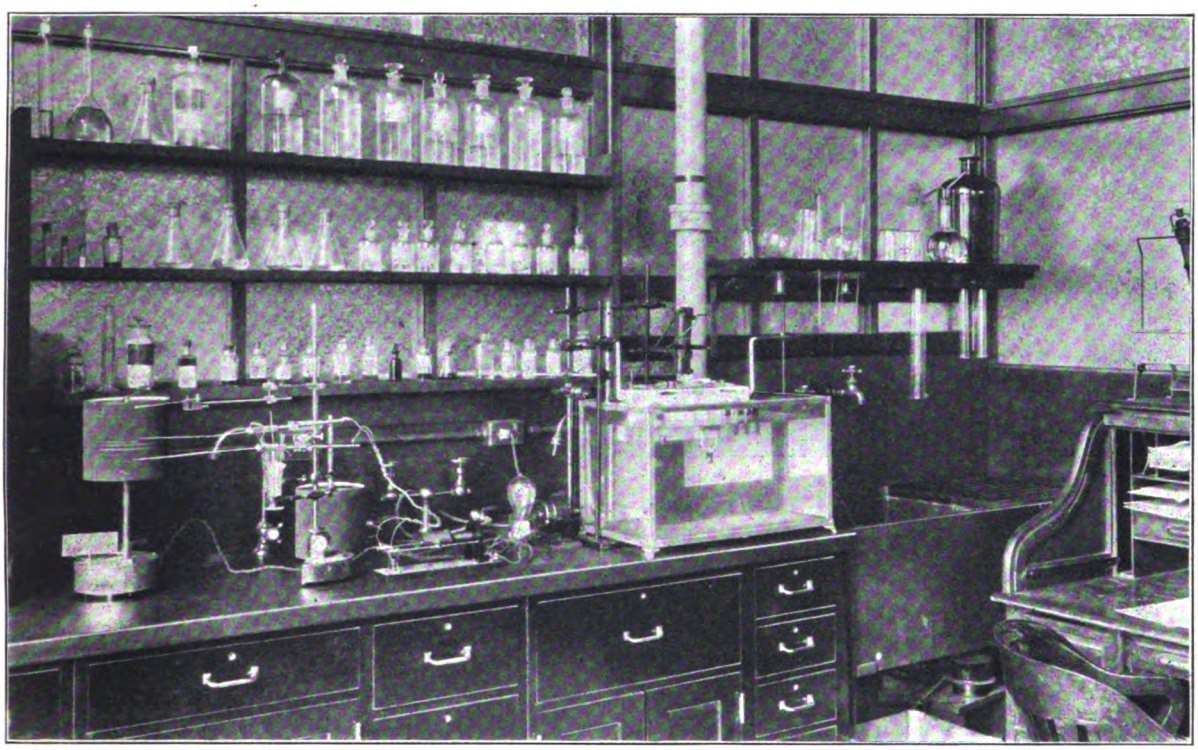

FIG. 3.—INDIVIDUAL STAFF LABORATORY

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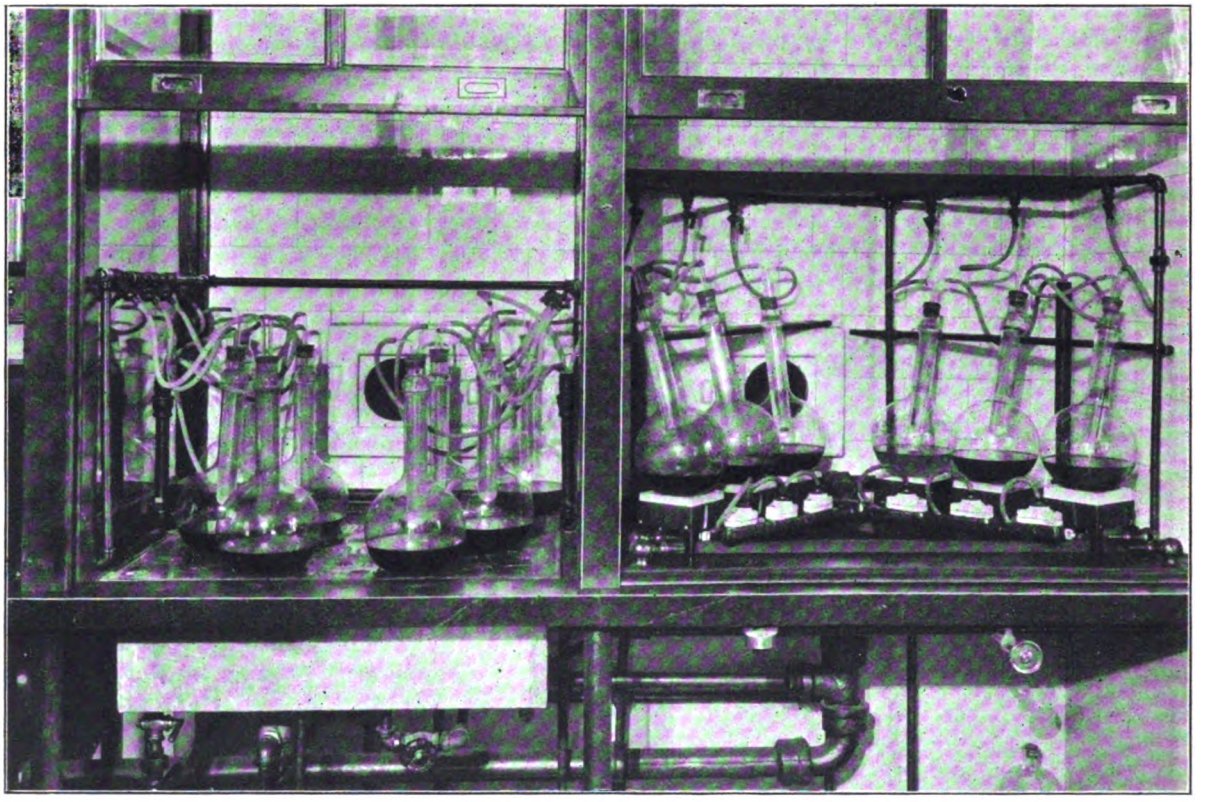

FIG. 4.—STEAM-BATH AND FUME-CHAMBER UNIT

of great importance in a subject as rich in details as is pharmacology.

These advantages of demonstrations can only be secured if certain conditions are fulfilled. The first requirement is that a student should see and understand what is going on essentially as well as if he were doing it himself. This requires careful planning and arrangement, an acquaintance with what the student already knows and of what must be shown; the proper location of the experiments on the lecture table; the use of magnification, general lighting, and spot-lights, mirrors, opaque and transparent projections; and the duplication of the smaller experiments to be passed around the class. All this must be adapted to the size of the classroom. Our lecture room is arranged so that sixty students have an unobstructed view, sufficiently close for almost any experiment when properly presented. The details of the technic cannot be shown as easily, but this is not necessary for students who have themselves done experiments in physiology involving the same technical principles.

It is also very important that the experiments be carefully prepared so that they will be practically sure to succeed. Unsuccessful experiments are usually worse than none. The demonstrators must practice in advance any experiments with which they are not thoroughly familiar; and they must have typical tracings, data, or other records in reserve, in case the experiment should not go well at the demonstration. The successive experiments of a demonstration must be timed so as to be ready in the proper sequence, for tedious delays tend to disperse attention. The time of each experiment is therefore worked out and scheduled in advance, and alternate experiments assigned to two or more demonstrators. The preparations are made for the most part in a commodious preparation room, adjoining the lecture room but out of sight of the students so as not to distract attention from the experiment under consideration.

One of the chief advantages of the demonstration method lies in the logical presentation of the subject, which is accomplished by an introductory talk, giving a brief review of the salient features of the physiology of the topic. From this the experiments are developed as much as

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possible as research problems. An effect is demonstrated; the possible explanations and possible methods of testing them are considered and then subjected to experimental proof. The class participates in these discussions and makes suggestions, which may be tried out if feasible. The conductor of the demonstration confines his attention to its presentation and discussion, leaving the execution of the experiments to the demonstrators.

The students are encouraged to take notes, as they would in personal experiments, and especially to draw critical conclusions and to work out problems of applications. It is impressed upon them, however, that notebooks are not an end in themselves but only a means to an end, a method of systematic study the details of which each student should work out to suit his individual needs. Extracts from these notes are read and discussed on the conference days which are interpolated between the experiment days. In this manner the students have an opportunity to learn the weak and strong points of their notes, and the instructors can see whether the experiments have been properly understood and whether the students are following the general plan of the course. Erroneous data are corrected, obscure points are discussed, conclusions and deductions are analyzed, the data from the various experiments are synthetized, and new questions are raised and either answered or left for further reflection. The students are encouraged to bring up any questions that may have occurred to them.

A review conference, held at the end of each chapter, may take the form of a lecture summarizing the subject or of questions especially directed to the same purpose. Throughout the course it is aimed to impress on the students the importance of seeing and thinking, of selecting the significant features and discarding the insignificant, of visualizing the phenomena, of making a critical analysis of conclusions, and of applying acquired knowledge to the solution of other problems. Mere memorizing is discouraged. Very little textbook work is required, nor is it even especially encouraged. On the contrary, the students are told to try first to solve their problems by themselves, as far as they can, before they seek the aid of books; but it is also impressed on them that the most profitable study is that directed to specific problems and questions in which interest has been aroused and to which thought has been given.

The doubts that might naturally arise *a priori* as to the value of substituting demonstrations for a large part of the individual laboratory work may deserve somewhat more discussion. The loss of practice in experimental technic is undeniable, but since the time ordinarily available does not suffice for both pharmacology and technic, there can be little question as to which should be sacrificed. In fact, however, the sacrifice is not serious, for if the student has not learned experimental technic at the proper time, that is, during the course in physiology, he is not apt to learn it in pharmacology. The few students who do have a special interest in technic may be given an opportunity to assist in the preparation of the demonstrations.

Much more serious is the loss of personal contact with and personal responsibility for the experiments; but this loss is also easily exaggerated. Observation directed carefully to this point will show that in experiments performed by groups of students the personal contact and responsibility is often delegated, by silent consent or definite plan, to an industrious or patient minority; that the others participate only as spectators of dilettante demonstrations; and that even those who do the work may lose more than they profit by responsibilities to which they are often not equal. This, as has been explained, is a special difficulty in pharmacological experimentation, because of the greater complexity of the experiments. A well-conducted demonstration is likely to secure more personal interest and more personal responsibility than is obtained in most group-experiments. However, group and individual experiments should be retained for certain special subjects, where they have distinct advantages. These may be performed after the demonstrations, or as separate class periods, according to the convenience of the schedule.

The time consumed in the preparation of the demonstrations may seem to be another objection. It is in fact a considerable item, but it is the most valuable training that the junior members of the staff could possibly receive. It furnishes an annual review that broadens their technic and their outlook into the entire field of pharmacologic experimentation; and it teaches them self-confidence. A well-trained mechanician, familiar with the traditions of the Department as well as with the experimental technic, is an invaluable aid which this Department fortunately possesses.

Courses 3 and 4. Systematic Pharmacology.—This is a conference course of sixty-four hours—eight hours in the last bimester of the second

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year and fifty-six hours in the first semester of the third year. It deals with a systematic and thorough study of the drugs or drug-groups that are of sufficient importance.

When Course 4 begins, the student has finished physiology and systematic pathology, as well as the course in experimental pharmacodynamics; he has had an elementary course in medicine, and generally some experience in the dispensaries; and he is attending clinical instructions in the hospitals. He is therefore well launched on the clinical portion of his career and intent on the considerable and somewhat perplexing task of blending the two sides of his medical training. This is the background on which the course of systematic pharmacology is projected.

From the standpoint of pharmacology proper, the course has the object of systemizing and expanding the data that were gathered in the course on experimental pharmacodynamics; of synthetizing these into a composite picture, a concrete concept of each of the more important drugs; and of learning their applicability to the treatment of disease. These are fairly complicated and rather personal problems, and they are handled from that standpoint. The instruction is carried out by conferences that are essentially an application of the principles of tutoring to large groups, in that they substitute a course of reading, with stimulating discussion of selected topics of special interest, for the indiscriminate spoon-feeding of formal lectures or "quizzes". The important drugs, for instance strychnine, caffeine, etc., are assigned successively for reading, and the students are given to understand that this reading constitutes the course, and that the class is held responsible for the entire subject and not merely for such portions of it as may be brought out in the conferences. These do not pretend to cover the whole assignment, but only such portions of it as appear to the instructor or to the students as especially worth discussing—not necessarily as especially worth learning. The instructor has a carefully thought-out tentative program of the points that merit discussion because they are especially difficult or confusing or misunderstood, or especially illuminating or characteristic or new; or because they illustrate how to study or how to apply the subject; or because they will test whether the studying is being done in the right manner. One or the other of these points may predominate. A conference may cover a considerable number of topics, within the assigned subject or indeed outside of it, or it may stay by a very few, or even by a single topic. It depends on circumstances, on the subject, and on the responses of the students. The main characteristic of the system is that there is no definite system, but only definite aims to be secured by whatever means appear most promising. Particularly, however, there is no system about the sequence of topics. These are selected from various parts of the assignments, so that the indifferent student is not beset by temptation to slight any part of the reading in the expectation that it may not be reached. If he does slight it, however, there is no adverse grade, no punishment except the consciousness of having missed that much of the benefit of the lesson.

In the conference the instructor proposes a question from his tentative program, gives a few moments for consideration, and then calls on a student, selected by lot from a package of cards, to open the discussion. Other students are then drawn into the subject by the same system, or enter voluntarily, the instructor framing the questions so as to bring out his intended point, or so as to raise other questions, until the point has been made. At times the exercise consists of a smooth recitation; more often perhaps in driving the student from one erroneous or imperfect or superficial conception to another until the error appears clear; at times the instructor gives a brief sketch of an involved or new subject. At the end of each "point" the discussion is thrown open to the class; and when it has once been established in the traditions of the student's world that the request for questions is *bona fide*, and that no *bona-fide* question is considered as impertinent, the result is most gratifying. Every effort is made to have the conferences perfectly informal, so that the students will actually feel "at home." Perhaps nearly half the questions in the course are asked by students; and sometimes the entire conference, after a few opening questions to break the ice, come from the students. These are the most fruitful part of the exercise, for they show the instructor where students really feel the need of help and what questions especially interest them. Naturally, some students are more industrious questioners than others, but it may be taken for granted that the problems they bring up are bothering many of the others; and the instructor, by the card system, generally manages to draw also the more reticent into the discussion.

The only apparent disadvantage of the sys-

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tem, that it does not leave time to cover the whole assignment, is perhaps one of its advantages, in that it makes the student feel more responsible for his own studies.

Incidentally this course also covers what is left of the old-time "materia medica." The chief preparations of the important drugs are set out for study, and the students are required to enter into columns of specially designed notebooks the correct name of the preparation, its approximate solubility or miscibility, its color, taste, and odor, and its dose. The number of these preparations is being progressively reduced. The notes are "inspected" at the end of each bimester; and the "test" requires a corresponding description of a few preparations. The materia medica topics enter rarely into the discussions of the conferences. They are studied by students from their text and from the specimens.

This concludes the course in pharmacology proper, and at the end practically every student has a knowledge of the subject that the writer considers adequate for the beginning practitioner of medicine. In fact, at the final examination, which is oral and covers the entire field of pharmacology, the writer is more impressed with how much the men know than with what they have missed. Often every man passes; rarely more than one or two are conditioned. This illustrates the point that medical students, when they become interested in a course, avail themselves of the opportunity it offers and that this interest, with intelligent and sympathetic guidance, is a sufficient incentive to hard work.

The conference system makes considerable demands on the instructor. In addition to spending a great deal of thought on his tentative program, he must be prepared, like the students, to discuss extemporaneously any phase of the work that may turn up. This, however, should be as interesting and as stimulating to the one as to the other.

Course 5. *Principles of Therapeutics.*—This is a lecture and conference course of forty hours in the second semester of the third year. It deals with the principles involved in the treatment of disease.

The course of systematic pharmacology pays considerable attention to the therapeutic application of the drugs; further consideration is given to the subject in the courses of applied therapeutics, and in all the clinical courses. However, there appears to be a distinct need for systematizing the scientific principles of

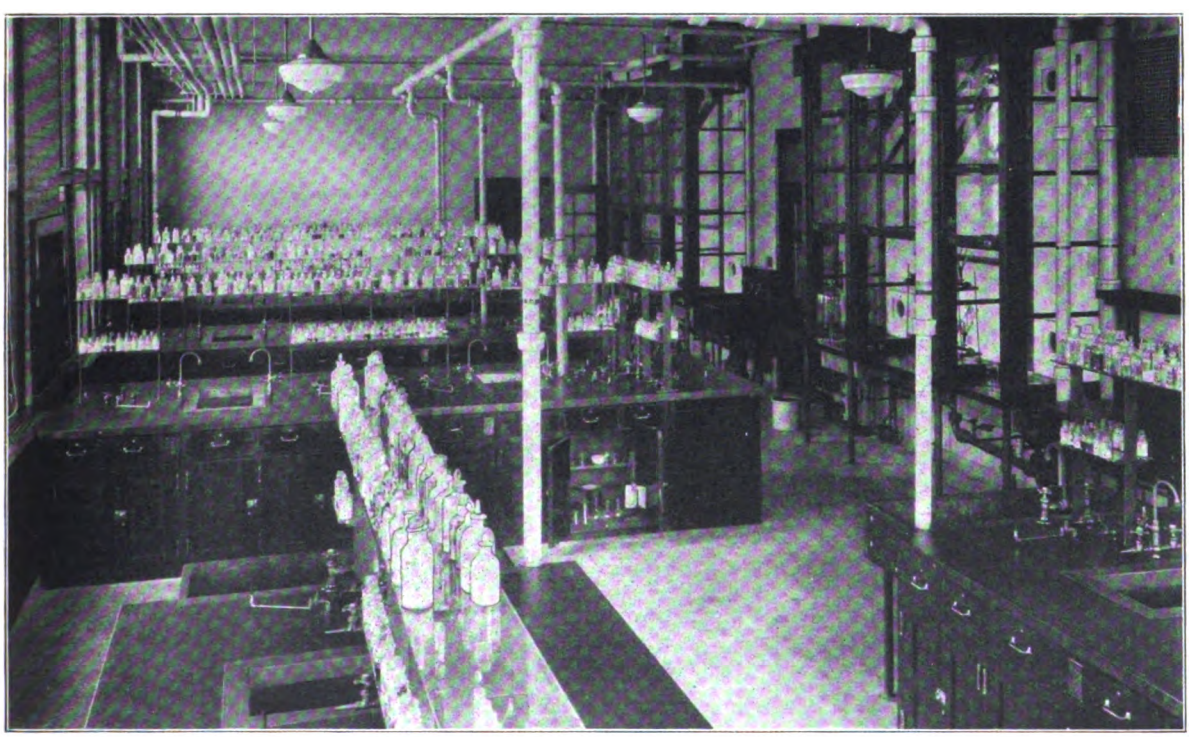

FIG. 5.—CLASSROOM FOR CHEMICAL PHARMACOLOGY

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this otherwise scattered information into a connected and logical form. This is the aim of Course 5, which takes up the various types of disease and considers briefly how the correction of the pathological condition could be approached and the results that may be expected. Its particular purpose is to illustrate how the treatment of disease may be rationally planned and critically followed, both experimentally and clinically.

IV. STAFF

The Department conceives its teaching function to extend not only to medical students, but also to the development of pharmacologists. Accordingly the assistants are given considerable practice in teaching. The course in chemical pharmacology is left largely in their hands. In experimental pharmacodynamics the assistants prepare the demonstrations, with the help of the mechanician, and they conduct many of the conferences. The director leads most of the demonstrations and of the review conferences. In systematic pharmacology the ranking instructor takes about one quarter of the conferences and the Director the other three quarters. The therapeutic course is given by the Director. The greater part of the teaching is therefore in the hands of the Director, and the junior men are able to profit by his direction. The teaching work extends through the entire session, but for the greater part of the time is fairly light for the individual members of the junior staff, so that they have ample opportunity to develop themselves in the subject, in research, and in teaching. The laboratory is also active during the entire summer. The regular staff consists of the Director, two full-time instructors of indeterminate grade, a secretary-librarian, a mechanician, a helper, and a janitor. There are also opportunities for a number of fellows. During the past year the Department had the privilege of extending its hospitality to workers from the China Medical Board, the Belgian Relief Fund, the Crile fellowship fund, the Dermatologic Department of Lakeside Hospital, and occasionally to workers from other departments.

The work of the regular staff is planned to give adequate opportunity for acquiring experience both in research and teaching, the proportion of the two varying according to the needs of the individual assistants. The whole organization is adjusted to classes of not more than sixty students. It is our present belief that larger numbers could most profitably be divided into units of this size, which would give opportunity of starting several classes at different times in the year. The staff and facilities would need to be correspondingly increased.

V. RESEARCH-POLICY

As this article deals mainly with the teaching policies of the Department, the discussion of the research functions, and the description of the quarters may be treated more briefly. However, the research and teaching policies are so interrelated that they cannot well be entirely separated. This relation is in part responsible for the broad scope of the investigations that have been carried on in the Department; for it has seemed to the director that a university department of pharmacology, which is engaged in training students and investigators in the entire subject, should be ready to encourage investigation in any part of the subject, so far as its resources may permit. On the other hand, individual workers or groups of workers within a department may well be encouraged to concentrate their efforts in a single direction. Both types of research, the extensive as well as the intensive, are needed in a subject that involves both fundamental and urgently practical problems, as does pharmacology. In these matters it is probably wisest to permit a wide latitude to the personal bent of the individual worker. With a view to this liberal policy, the quarters and the equipment were planned and are kept elastic.

At the present time the following problems are under investigation by the staff:

Intestinal persistalsis in relation to saline cathartics and to bacterial toxins.

The cardiac gradient, especially in relation to ion actions.

The cardiac actions of autonomic drugs.

The quantitative excretion of mercury.

VI. DESCRIPTION OF QUARTERS

The unit construction of the medical building has been explained in Dr. Wigger's paper (page 56). Briefly, the building is laid out in units 15 feet wide by 25 feet deep, separated by a 10-foot corridor. It will be convenient to describe the space in terms of these units.

The third floor of the U-shaped building houses, in the east half of the U, the department of experimental medicine, and in the center five units for experimental surgery (see page

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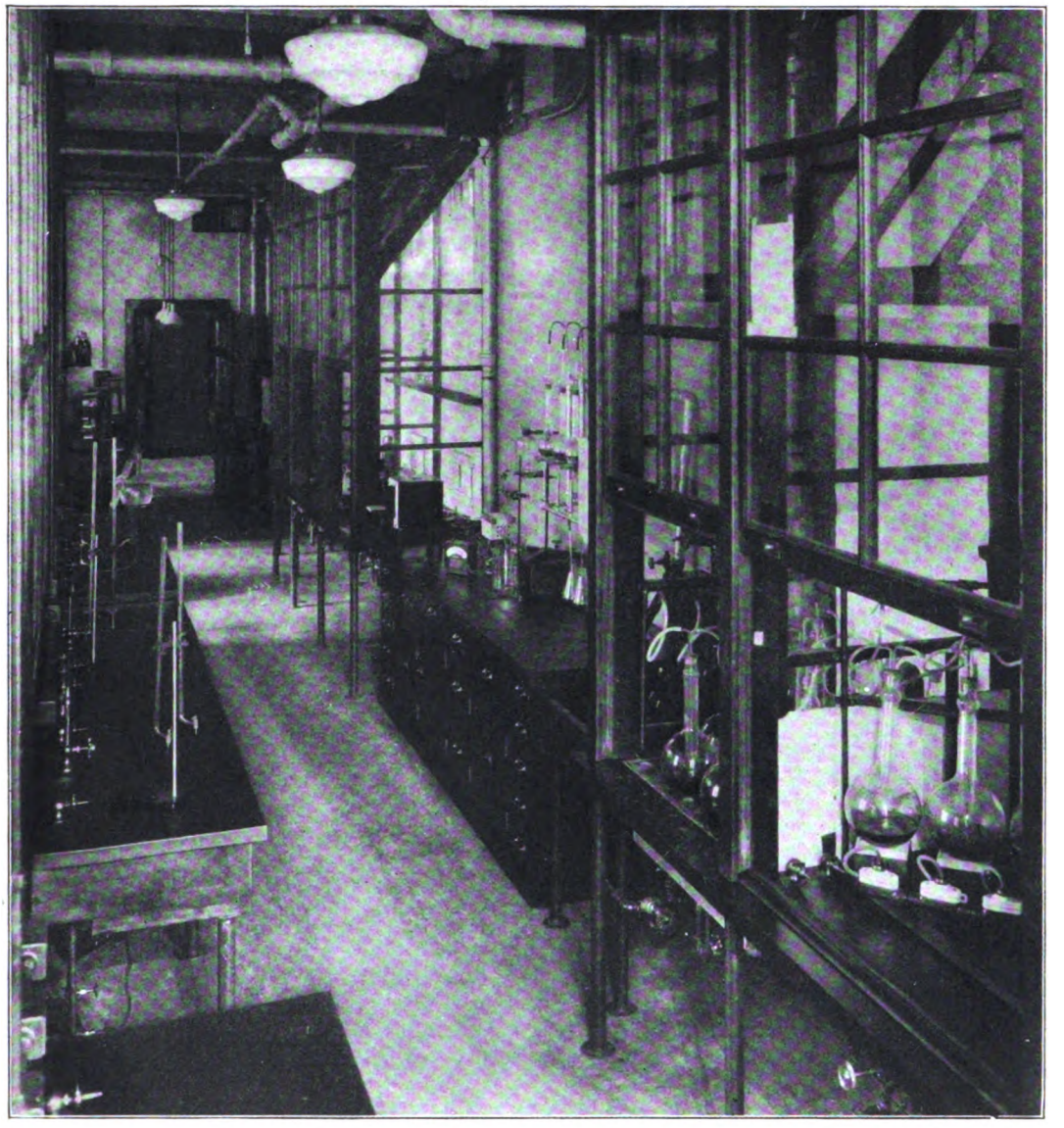

FIG. 6.—SERVICE CORRIDOR FOR STAFF

51). The west half of the center is occupied by the teaching rooms used by the three departments on this floor, and the west wing houses the staff and research quarters of the Department of Pharmacology. As the bulk of the teaching is in pharmacology, the teaching rooms are considered an integral part of this department.

The teaching quarters comprise a lecture-demonstration room of two units, with adjoining preparation room (one unit), which opens into the students' laboratory of chemical pharmacology (five units). Across the corridor is the experimental laboratory (five units). At the corner, centrally accessible to all these, is the storeroom (two units); and around the corner are the cold room and hot room.

The departmental wing begins on the west side of the corridor with the departmental library (three units), which opens into the Director's study and laboratory (two units). The remainder of the west side is devoted to staff rooms for chemical and frog work (three units), with the end room (two units) planned especially for physical chemistry. The other side of the corridor is intended mainly for experimental work; two units for acute mammalian experiments, one unit for the mechanic's shop and office, one unit for animal cages, one for an

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operating suite, and one for advanced workers.

The Department also has two units in the basement, which are used for storage and for small animals. Larger animals are housed in the common kennels, paddocks, and hospital rooms.

Every room receives splendid natural light, as about two thirds of the outer wall space is of glass and the medical building is situated an adequate distance from other buildings. The artificial illumination has also been planned to with water, gas, air, vacuum, and with 110 volt, 8 volt, and 2 volt current. These permit the liberal use of special lighting and of spot-lamps, which help very much to bring the important features of experiments into prominence. (This is illustrated in the figure by the tracing on the left of the lecture table.) The room itself receives splendid north light, and has a most satisfactory artificial illumination, with graduated control, for lantern work. The projection may be made from the rear of the lecture room, or

FIG. 7.—EXPERIMENTAL LABORATORY

the greatest advantage. The stimulating effect of the lighting is very striking.

The physical equipment and services were designed for flexibility. Practically every unit has numerous connections for water, gas, steam, lighting current, power current, variable voltage storage current, compressed air and vacuum, and excellent hoods and steam baths. The chemical benches and apparatus cases are constructed of standardized, interchangeable units. Some of the arrangements may be described more fully.

The Lecture and Demonstration Room (Fig. 2) has seven rows, each of nine comfortable chairs, the last row being twenty-two feet from the lecture table. Risers of seven inches give an unobstructed view. The lecture table is provided from the preparation room, with a translux screen in the opening of the sliding blackboards. This window is also used, as shown in the figure, for passing experiments from one room to the other. One section of the lecture table is movable, so that it may be rolled into the preparation room, for instance, for operations. The two doors between the rooms prevent confusion when different experiments are being set up at the two ends of the table.

The Laboratory of Chemical Pharmacology (Fig. 5) is similar to ordinary chemical laboratories. The tables are supplied with compressed air and vacuum, and with storage battery or power current, so that they may also be used for experiments on smaller animals and on

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excised organs. The hoods are equipped with steam baths; and the cold and hot rooms are in close proximity.

The Experimental Laboratory (Fig. 7) is used for different kinds of work by three departments. Flexibility has therefore been especially emphasized in its design. All the services, including two voltages of storage current, are confined to the wall tables. All the furniture on the floor of the room is freely movable. At each end of the room is a preparation and issue room, one for experimental medicine and surgery and the other for pharmacology. The latter communicates with the storeroom. Another special feature is a row of slate stalls in an inner corridor, close to the elevator, to which the morphinized animals are brought before the class assembles.

The Chemical Service Room (Fig. 6): The staffrooms open on a long anteroom, 10 feet wide and 45 feet long, lined on one side with fume chambers, steam baths, ovens, and alberene-topped tables, and on the other with tables for titrating, etc. This combines the privacy of the personal staffrooms with the flexibility of the common use of the bulky services. Figure 3 shows a corner of a typical staffroom, and Fig. 4 a fume and steam-bath unit in the corridor.

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WESTERN RESERVE UNIVERSITY SCHOOL OF MEDICINE DEPARTMENT OF PATHOLOGY

BY

HOWARD T. KARSNER, M.D.

PROFESSOR OF PATHOLOGY

INTRODUCTION

The Department of Pathology, School of Medicine, Western Reserve University, occupies space in the new building of the School of Medicine and in the three hospitals formally affiliated with the School. The professor of pathology is visiting pathologist to each of these hospitals and when the group of new buildings upon the University campus is completed it is anticipated that he will also be pathologist to the health group. In each hospital there is a laboratory staff nominated solely by him. Intimate association of the school department with the hospital departments and the hospital departments with each other is not only a matter of form of organization but of fact. The resident pathologists in the hospitals have University rank and take an important part in the teaching of the second-, third-, and fourth-year work. They are preceptors for the second-year class, direct the autopsy work of the third year, and assist at the clinical pathological conferences of the fourth year. The second-year students are in the hospital laboratories one period of each week throughout the course. In addition, one hour a week is devoted to work with material from the hospital autopsies, always correlated with the clinical aspects of the specimens. Training in the method and practice of the clinical pathological conference is begun in the second year, further elaborated in the third year, and continued in the fourth year.

The basis of the teaching of pathology is pathological anatomy and histology and the situation of the laboratories in the School building is especially favorable for class experimental work. It provides for co-operation, not only in teaching but also in investigation, between pathology and such subjects as anatomy, histology, physiology, biochemistry, bacteriology, and pharmacology. The administration of this general plan requires the combined efforts of the strictly University staff. The personnel has been carefully selected on the basis of interest in pathology as a subject with practical application in the hospital and school, as well as a diversified science which needs much expansion on the basis of investigation. The appointments to the staff are entirely devoid of local prejudice and include at present graduates of the universities of Pennsylvania, McGill, Chicago, Wageningen, Nebraska, Yale, Vienna, Johns Hopkins, and Western Reserve, and Jefferson Medical College.

BUILDING AND EQUIPMENT

The Department of Pathology occupies the first two floors of the west wing of the School of Medicine and in addition has stockrooms, storage space, and a photographic room in the basement. The second floor is devoted to private work rooms, offices, library, secretary, and technician. The teaching activities are concentrated on the first floor, with classroom, amphitheater, museum, refrigerator, incubator room, and one stockroom for issues to students, all in physical contact. The rear of the wing on this floor is given over to special rooms for immunology, chemistry, physiology, aseptic operations, and animal observation. As the rooms are used for a part of each year by the students they were planned so as to be near the teaching units.

FIRST FLOOR

The classroom for microscopic work has a frontage as nearly to the north as the plan of the building will permit. In this room are ten work tables, each of which accommodates six students. Each table is provided with an unusually excellent type of artificial lighting system for microscopic purposes, two four-way gas cocks, and a small sink with hot and cold water at the

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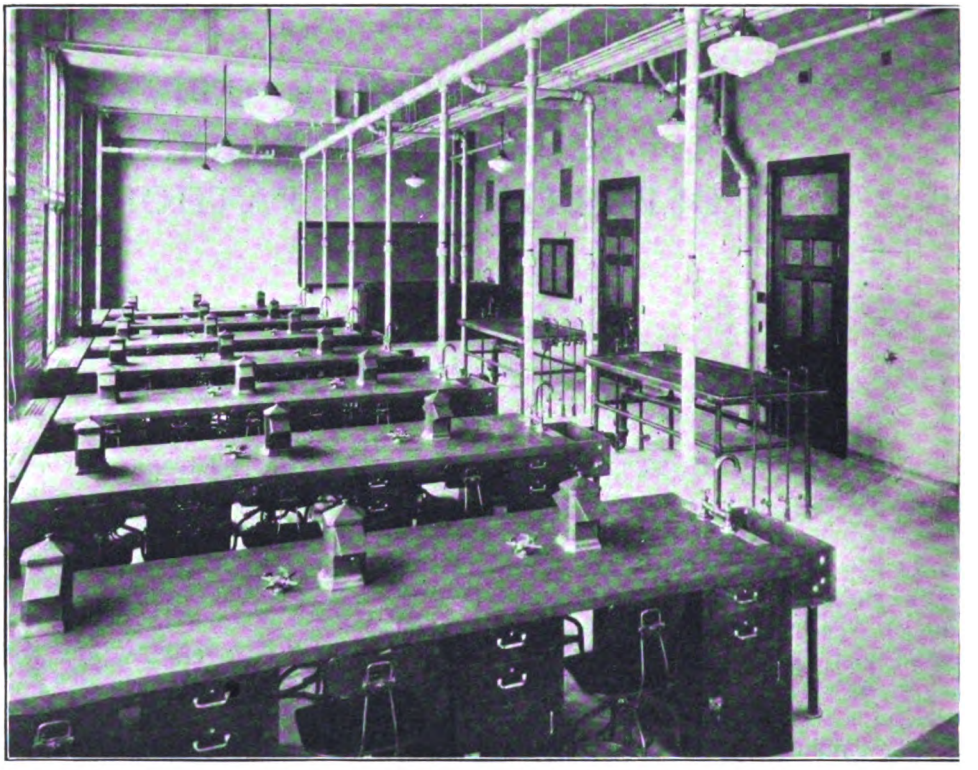

FIG. 1.—CLASSROOM SHOWING TABLES FOR MICROSCOPE WORK WITH ARTIFI-

end. There are also three large alberene tables equipped with hot and cold water, electric power, gas, air and vacuum, to permit experimental work as well as the exhibition of gross morbid anatomical material. Equipment such as centrifuge, water bath, and similar apparatus is provided in this classroom. Transient supplies, microscopes, etc., are issued from the stockroom directly across the hall. The amphitheater is so designed that it may be used for demonstrations of gross morbid anatomy and of living patients, micro-projection and lantern slide projection, and occasional demonstration autopsies. The seats are arranged to afford a clear view of the demonstration table to any occupant either sitting erect or leaning forward on the rails and the table is equipped for physiological and other experiments. Although the museum could be used at any time for exhibition purposes, it is designed principally as a storage museum from which specimens can be issued for demonstration by any of the laboratory or clinical teachers. An index and cross index give ready access to the preparations. On the same floor are units for immunology, physiology, chemistry, and animal operations as well as observation rooms for animals which are under study. Additional space for animals is provided in the animal hospital and to these quarters are assigned animals that are used only occasionally or are the subjects of long time experiments. Inasmuch as the students use these special rooms for only a short period during the course of the year the equipment is used not only by the students but also for the research work of the staff. Thus the students use the same high-type equipment as is employed for investigative work.

There is also a large, well-equipped room for advanced students which is used by practicing physicians and junior members of hospital staffs who wish to conduct special studies in the field of pathology. Lockers and closets for eight individuals are provided.

SECOND FLOOR

On the second floor are the office of the secretary, the departmental library, the technician's room, private rooms for members of the staff, and a laboratory unit, thoroughly equipped for all types of experimental work, which is employed for studies where constant attention is required and for which the equipment is not necessarily provided in the special rooms on the first floor. In this unit the services are complete, including

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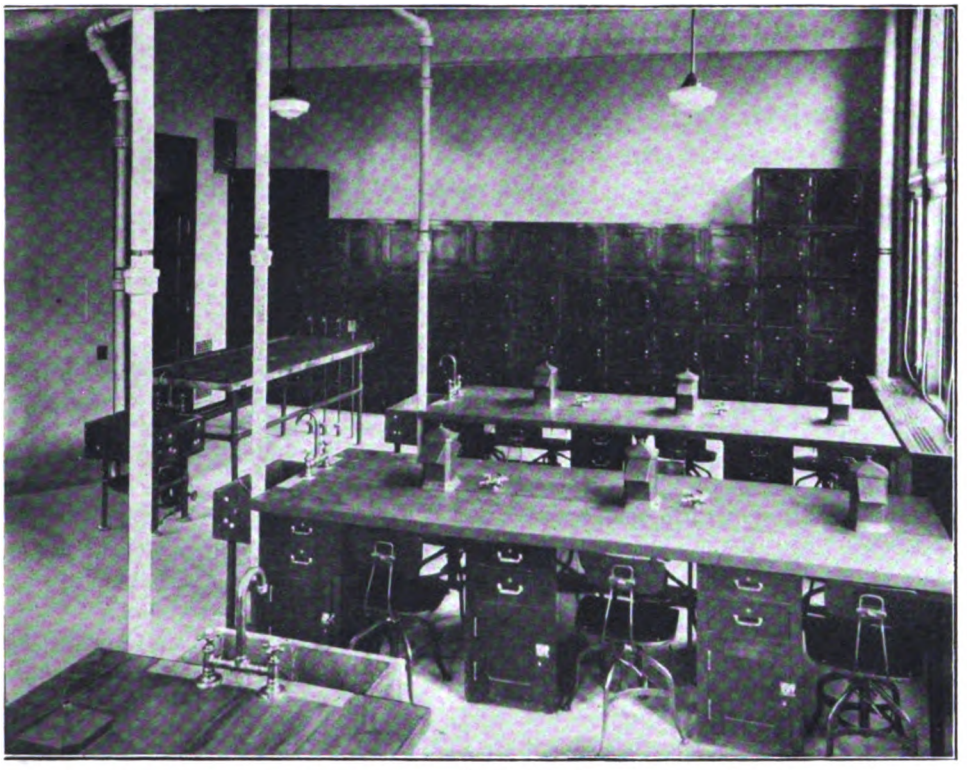

CIAL LIGHT UNITS AND ALBERENE TABLES FOR DEMONSTRATION PURPOSES

a fire-proof closet, an incubator closet, gas, compressed air, vacuum, hot and cold water, live steam, and three electric lines so arranged that there are five possibilities as to direct current, namely, 110 and 220 volts on the lighting lines, 110 and 220 volts on the power lines, and a range of from 2 to 15 volts on the low-voltage lines. In the middle of the room is a large chemical table fully equipped. Each private room has desk, library table, chairs, stools, bookcase, work sink, wash-basin, clothes closet, and a window bench with microscope light, gas, air, vacuum, electric light, and electric power outlets.

The photographic room is equipped for gross photography, microphotography, printing, enlarging, reducing, and the making of lantern slides.

MICROSCOPE LIGHTS

The artificial lights for miscroscopic work deserve a special note. They are standard throughout the building for teaching and research purposes. The housing is of sheet and cast aluminum, 11 inches high and 6 inches square. The lights for students' use in classrooms have 3¼-inch openings, on two opposite sides of the housing, which are shaded by hoods to prevent glare upward and to the sides. In the special and private laboratories the units are portable and have an opening and hood on one side only. The cover provides ample ventilation and is locked on by a key. The illuminant is a 150-watt gas-filled Mazda lamp. There are two square sleeves inside the housing, the outer one with a "daylight" bull's-eye and the inner one with a 3-inch circle of ground glass. One side of each sleeve has an unfilled opening. Thus the worker may use bare lamp, white diffusion, "daylight" blue, or diffusion and "daylight." The lamp is so fixed that when the microscope mirror is 18 inches away from the lamp the rays pass through the middle of the bull's-eye. The combination of diffusion and "daylight" gives a soft light sufficiently strong for satisfactory work with the oil immersion lens. The light was designed by three members of the faculty with the co-operation of the engineer who planned the electrical equipment of the building.

LIBRARY

The departmental library contains more than 1,600 volumes and includes complete files of the more important journals in pathology and related subjects in English, German, and French. The library, the classroom, and the museum are

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open to students at all times except Sundays and holidays, when they must have special permission.

METHOD OF TEACHING

The fact that the School of Medicine is affiliated with three large hospitals means much for the teaching of pathology. The professor of pathology is, by virtue of his professorship, visiting pathologist to Lakeside Hospital, Cleveland City Hospital, and St. Vincent's Charity Hospital. By special arrangement he is consulting pathologist to Mt. Sinai Hospital. The material available for teaching and study is therefore derived from hospitals with a total capacity of more than 2,000 beds. In the year 1924 there were performed under the supervision of the professor of pathology more than 800 autopsies, the surgical specimens examined exceeded 7,000, the Wassermann tests numbered about 15,000. Various other laboratory items were covered in much the same proportions. This makes it possible to conduct the teaching of gross morbid anatomy almost entirely with fresh specimens, which are brought to the University building and kept in the refrigerator adjacent to the amphitheater and the classroom for subsequent demonstration. Material derived from experimental work and specimens removed surgically are available for teaching.

The clinical phases of pathology are emphasized rather than the more purely scientific side. The subject of pathology constitutes the application to the study of disease of what the student has already learned in anatomy, physiology, biochemistry, and bacteriology. In all stages of the work constant reference is made to normal form and function. Although the basis of pathology must be morphological, every effort is made, by experiment and by reference to clinical subjects, to correlate abnormal form with abnormal function.

Recognizing the fact that the chief purpose of teaching is to develop interest, the second-year class is divided into four sections and on Tuesday mornings each section spends two hours in the laboratories of the affiliated hospitals, under the direction of the hospital pathologists. During these periods the students become familiar with the character of hospital laboratory work and the relation of pathology to the living patient. Each hospital pathologist spends at least one day a week in the routine teaching work and is thus familiar with what is going on in the university courses. From the assistants in the Medical School and the hospital pathologists a group of seven preceptors or tutors is selected. The second-year class is divided into seven corresponding groups, which are in preceptorial relationship with these instructors throughout the course. The preceptor meets his group at least once a week and discusses the subjects being studied at that particular period of the course. In addition he is constantly available for consultation by members of his group regarding any matters, academic or personal, upon which the student desires advice.

The regular teaching of second-year pathology is concentrated into four months and occupies 332 hours. Of the time allotted, about two fifths are devoted to general pathology and about three fifths to systemic pathology. This proportion is determined with the idea that systemic pathology will better train the student for his later clinical work and permit a more detailed correlation of morphological lesions and functional alterations. Explanatory lectures by the professor occupy from two to three hours per week and are closely correlated with the laboratory work in gross morbid anatomy, pathological histology, and experimental pathology. This work is supplemented by quiz conferences conducted by the professor or assistant professor, lantern demonstrations, microscopic projection, and written tests. Mimeographed notes accompany the permanent collection of microscopic preparations.

During the study of general pathology the experimental work is devoted entirely to immunology. The microscopic preparations to be studied are assigned not by days but by periods of a week or ten days so that the students have the greatest freedom in apportioning their time. This permits of the performance of certain fundamental experiments in immunology by the entire class and for this purpose the centrifuge and water bath are available in the classroom. Mimeographed notes of the experiments in immunology are provided for each member of the class.

As an example of the teaching method, the entire class performs an experiment in toxin-antitoxin union with tetanolysin and tetanus antitoxin. A small section composed of from four to six students then works out, in the special room provided for immunology, further details of toxin-antitoxin union not only in reference to tetanus toxin and antitoxin but also diphtheria toxin and antitoxin. The results of these experiments are demonstrated to the entire class and entered with the mimeographed notes.

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The same program is applied, after the performance by the entire class, to agglutination and is repeated with precipitation, cytolysis, and complement fixation. Anaphylactic shock and inhibition of shock are demonstrated in the amphitheater. The students are required to hand in a notebook of the results of the experiments built upon the basis of their mimeographed notes. The assistant professor of immunology gives lectures and conducts quiz conferences at suitable periods

hydropericardium, aortic stenosis, aortic insufficiency, and experimental myocardial degeneration, infarction, and air embolism. With the multiple stethoscope, all students hear the murmur of aortic stenosis. Previously they have learned the method of opening the heart by practice on calves' hearts and during the period of study of circulation are constantly engaged with morbid anatomical preparations. At the end of the period assigned to circulatory diseases the

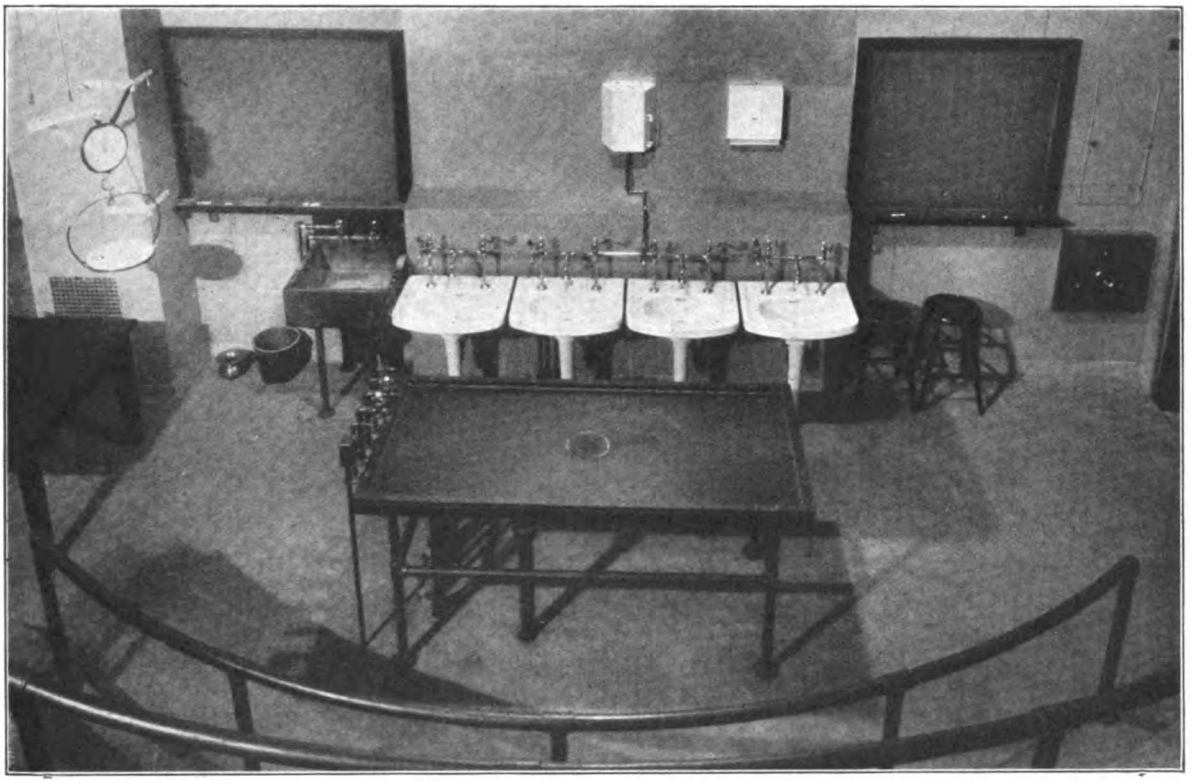

FIG. 2.—VIEW OF FLOOR SPACE IN AMPHITHEATER WITH FACILITIES FOR DEMONSTRATIONS AND WORK ON THE PART OF THE STUDENTS

which do not conflict with the didactic work in pathology.

During the course in systemic pathology the pathological histology is closely correlated with gross morbid anatomy. In addition, experiments are performed annually in connection with the study of the circulatory system, respiratory system, and kidney. If time permits, there also are experiments dealing with diseases of the lungs, liver, pancreas, and alimentary canal.

During the periods when circulation is being studied groups of five students work in the physiology room under the direction of the professor or assistant professor, each group studying with the kymograph the effects of such conditions as

students assemble at one of the hospital amphitheaters where one hour is given to a quiz conference on gross morbid anatomy of heart disease, one to the demonstration of the physiological results obtained by the small groups, and the third hour to the presentation and examination of living patients with heart disease.

The experiments in the respiratory tract deal with the effects of hydrothorax, acute asthma of anaphylactic shock, acute bronchitis from irritant gases with auscultatory demonstration of râles, and experimental pneumonia. The physiological work in renal disease is concerned principally with the production of experimental nephritis, the study of accumulation of nitrogenous

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FIG. 3.—SEATING ARRANGEMENTS IN AMPHITHEATER, AND THE PROJECTION APPARATUS

products and the execretion of phenolsulphonephthalein. The same type of correlation period spoken of in connection with heart disease follows the work on kidney disease.

In the fourth semi-semester of the second year eight periods are given at Lakeside Hospital by the assistant professor, in which the students are trained in the methods of the clinical-pathological conference. Two cases are usually covered in each period. Two students present an abstract of the clinical history and differential diagnosis and two other students present the organs from the autopsy. The students then discuss the features disclosed. In the third year

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the work in pathology comprises attendance upon autopsies at the associated hospitals and, during the fourth semi-semester, eight clinical-pathological conferences at the medical school under the direction of the professor similar to, but more advanced than, those of the second year. The students are assigned to autopsies in groups of not more than four. This assures close observation of the autopsy method and findings as well as an opportunity to assist in the work. Cards are furnished which must be filled out and returned to the Department office indicating the place of autopsy, the name of the patient, the clinical condition, and a review of the pathological findings. No student is accepted for graduation with a credit of less than six autopsies; many students observe ten or more; and occasionally a student has credit for twenty or more.

In the fourth year the clinical clerks at City Hospital and at Lakeside Hospital attend the weekly staff clinical-pathological conferences. Thus during this year each student attends approximately sixteen such conferences.

Elective courses are offered in general pathology conducted in the Hospital laboratories, immunology conducted at the medical school, and gynecological pathology conducted in co-operation with the division of gynecology. Fourth-year students are admitted to clerkships in pathology in the hospitals and, if properly qualified, may conduct research in pathology and immunology.

In this School, pathology and bacteriology are in separate departments. Bacteriology is taught in the latter part of the first year and is a necessary pre-requisite to entrance upon the course in pathology. In the study of the pathology of infectious diseases constant reference is made to the preceding work in bacteriology which has been taught in the fourth semi-semester of the first year. Naturally the experimental and didactic work in immunology require constant reference to bacteriology. The most cordial relations exist between the two departments and every attempt is made to correlate the two in so far as their place in the school schedule will permit.

FIG. 4.—SECTION OF MUSEUM AVAILABLE FOR EXHIBITIONS BUT USED PRINCIPALLY AS A SOURCE OF SUPPLY FOR DEMONSTRATION AND STUDY BY THE ENTIRE TEACHING STAFF

RESEARCH

At the time this article is being written sixteen investigative studies are being carried on in the Department. The removal of the laboratory to

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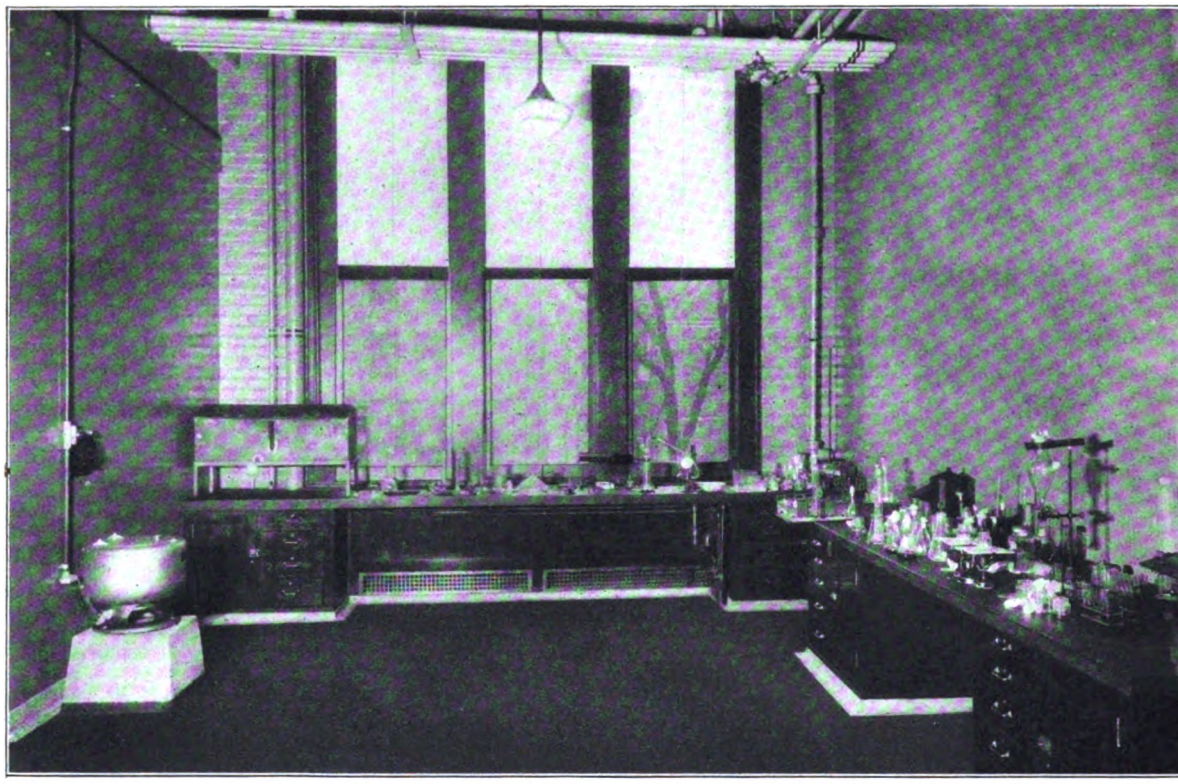

FIG. 5.—SPECIAL ROOM FOR IMMUNOLOGY, TYPICAL OF THE ROOMS ON THE FIRST FLOOR FOR USE OF STUDENTS AND STAFF

the new building interrupted several studies conducted by practicing physicians, which will be resumed in the near future. The anatomical studies are directed principally toward problems in the circulatory apparatus and include a study of segmentation of the myocardium, hypertrophy of the heart, the effect of increased metabolism on the production of arteriosclerosis, and an investigation of lipemia and fat embolism. In connection with a series of studies on experimental rickets there are several investigations of ultraviolet irradiation, the biochemistry of calcium, rickets-producing diets, and the anatomy of rickets in certain animals not hitherto employed extensively for this purpose. A prolonged study of the influence of high concentrations of oxygen in the atmosphere is now directed toward the growth of pathogenic and non-pathogenic moulds. In the field of immunology the physiological effects of the so-called X substances of organisms of the paratyphoid group and a distinct and separate study of the toxins of the scarlet fever streptococcus are being conducted. There is also a further study of the problem of anaphylactic shock and its inhibition. Every member of the University Department is devoting a large share of his time to investigative work. The affiliated hospitals also make provision for investigative work by the resident pathologists and in three of the hospitals such work is being prosecuted as actively as time will permit.

CORRELATION WITH OTHER DEPARTMENTS

A cursory review of the methods of teaching pathology in this School will illustrate the fact that correlation with the other departments is an absolute essential. Pathology, looked upon as the study of abnormal anatomy and physiology, must be closely correlated with those subjects and with bacteriology, hygiene, and biochemistry. Frequent conferences are held with the heads of these departments so that the abnormal form and function are related to normal form and function and the etiological agents of disease. The numerous student and staff clinical-pathological conferences, the emphasis upon the clinical aspects of cases coming to autopsy, and constant reference to the practical application of the subject in the regular course, provide close correlation with the clinical subjects.

The design of the building is such as to indi-

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cate that facilities and space for research are of the utmost importance in the work of the School. After occupation of the building no time was lost in making use of the facilities and equipment provided. There is an interest on the part of each department in the research going on in the others. Conference and advice can invariably be obtained with the greatest readiness. Of the research studies outlined above collaboration is being furnished by the departments of anatomy, biochemistry, pharmacology, and surgery and the equipment of these departments is employed for part of the work.

STAFF

The professional staff includes the professor of pathology, the assistant professor of pathology, the assistant professor of immunology, the instructor in pathology, the Hanna research fellow in pathology, and at the present time a fellow in pathology from the National Research Council. All these members of the staff give their entire time to the teaching and research work of the Department and the associated hospitals. The non-professional staff includes a secretary, a technician, a mechanic, an orderly, and a janitor.

By the arrangement of having the hospital pathologist aid in the teaching and research work of the Department, the closest association between the various laboratories is assured. This means not only association with the University Department but also between the hospital laboratories. Frequent visits are exchanged between members of the hospital staffs and the clinical-pathological conferences are frequently attended by members of the staffs of the other hospitals. The professor of pathology makes all nominations for the hospital staffs. The work of the hospital pathological laboratories is paid for entirely by the hospitals and does not appear on the University budget. Occasionally research studies in the hospital laboratories are aided financially by the University but as a rule the hospitals provide all the funds. At the Lakeside Hospital, which is to be regarded as the University hospital, members of the University staff serve as visiting pathologist, associate visiting pathologist, visiting immunologist, assistant visiting surgical pathologist, and associate visiting clinical pathologist. These persons make frequent visits to the hospital laboratories and are on call at all times for aid. In recognition of the services thus rendered to the hospitals by the University, the hospital authorities permit their appointees to aid in

FIG. 6.—INSTRUCTOR'S ROOM ON SECOND FLOOR EQUIPPED TO SERVE AS OFFICE, STUDY, AND PRIVATE LABORATORY

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the teaching work. The hospital pathologists realize the advantages to be gained by entering upon teaching work and by the frequent contacts not only with the staff of the University but also with the students. These workers are given academic titles in the Department staff. At the City Hospital an assistant professor of pathology is pathologist and is assisted by a resident pathologist and an assistant resident pathologist; at Lakeside Hospital an associate in pathology is pathologist and is assisted by a resident pathologist and an interne in pathology; at Mt. Sinai Hospital an associate in pathology is pathologist and is assisted by a resident pathologist; at St. Vincent's Charity Hospital a demonstrator of pathology is resident pathologist. The hospital laboratories are well equipped, adequately maintained, and served by an ample stenographic and technical staff.

FIG. 7.—CORNER OF LIBRARY, WHICH HOUSES THE GUTHRIE MCCONNELL MEMORIAL COLLECTION

BUDGET

There is no separation of items in the budget to indicate with any degree of exactness what proportion of the funds is intended for the research activities. Therefore, the items given below for maintenance cannot be subdivided. During the year about 350 hours are devoted to undergraduate teaching but the clinical-pathological conferences are also in part for the education of the fourth-year students and internes in the hospitals and hospital staffs. This would occupy a considerable amount of time of the members of the staff. Nevertheless, the teaching work and the hospital responsibilities leave a large share of time available for investigative studies. It must be recognized that the hospital laboratories are essential to the prosecution of teaching work in pathology, but it is impossible to estimate how much of their budgets is to be applied toward the activities in teaching. The University budget, which covers also the subdepartment of immunology but does not include the subdepartment of clinical pathology, is approximately as follows:

Salaries of professional staff.....	$18,250
Salaries of technical staff.....	5,580
Maintenance and research.....	3,750
University total.....	$27,580
Total for hospitals, about.....	40,000
Approximate grand total.....	$67,580

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CLINICAL PATHOLOGY

In the organization of the various teaching activities of the Medical School, those which have to do with clinical pathology are assigned to the Department of Pathology. The classroom, used by the Department of Pathology, the stockroom immediately opposite, and all of the units in the Department of Pathology are available for the use of the division of clinical pathology. The administrative and preparation work of clinical pathology occupies two units so subdivided that there is an office, an incubator room, a room for serology, one for general preparation and one for chemical purposes.

The facilities for teaching this subject are extensive. In addition to the material derived from the three hospitals associated with the University, the hospital connections of the teaching staff in clinical pathology make it possible to get material from three other hospitals. The equipment in the division of clinical pathology, that in the classroom and amphitheater, as well as the occasional utilization of facilities in the Department of Pathology provide adequately for the teaching work. The teaching is conducted in the fourth semi-semester of the second year and the first two semi-semesters of the third year. In the fourth semi-semester of the second year the students are trained in the methods of morphological and clinical examination of the blood. This takes advantage of what the students have learned in anatomy, histology, and pathology and prepares them for the more intricate work of the third year. In the third year the students are trained in the general methods of the clinical laboratory, including the chemical examination of the blood, examination of the urine, and various other body secretions and excretions, applied immunological and bacteriological examinations, and parasitology with especial reference to the feces and blood. In addition to permanent preparations for the routine work in the course, numerous specimens of blood, stomach contents, urine, feces, etc., are brought from the associated hospitals and presented to the student for examination, with a clinical history of the particular patients concerned. The students themselves are also the subjects for experiments by their colleagues, dealing particularly with the blood, concentration of urine, output of phenolsulphonephthalein, and other similar procedures. Throughout the entire work the attempt is made to correlate this subject with all that has gone before in the student's medical career and prepare him for the clinical clerkships upon which he enters during his fourth year.

The staff is composed of part-time teachers who are either practitioners of medicine or occupy some post in hospital laboratories. The associate professor of clinical pathology is, by virtue of his office, associate visiting clinical pathologist to Lakeside Hospital and to the outpatient service of Western Reserve University and Lakeside Hospital. He has also other hospital posts. The staff comprises the associate professor, two demonstrators, and one technical assistant. The budget is as follows:

General maintenance	$750
Salaries of professional staff.....	1,800
Salary of technical staff.....	1,320
Total	$3,870

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WESTERN RESERVE UNIVERSITY SCHOOL OF MEDICINE LABORATORY OF ANATOMY

BY

T. WINGATE TODD, M.B., CH.B., F.R.C.S. ENG.

HENRY WILLSON PAYNE PROFESSOR OF ANATOMY

I. TEACHING AND ORGANIZATION

The curriculum of the Western Reserve University Medical School is organized under ten departments, of which one is Anatomy, including histology and embryology.[1] For purposes of administration and teaching there are two full professors, one of anatomy and the other of histology and embryology. Each controls his own section of the group and to this end prepares his own separate budget and supervises its expenditure. Naturally there is much interlocking and no hard and fast lines can be drawn. The present report deals solely with the activities of the Laboratory of Anatomy.

As the Laboratory of Anatomy is at present organized it includes gross anatomy with its

[1] Catalogue School of Medicine, 1924-1925, p. 62.

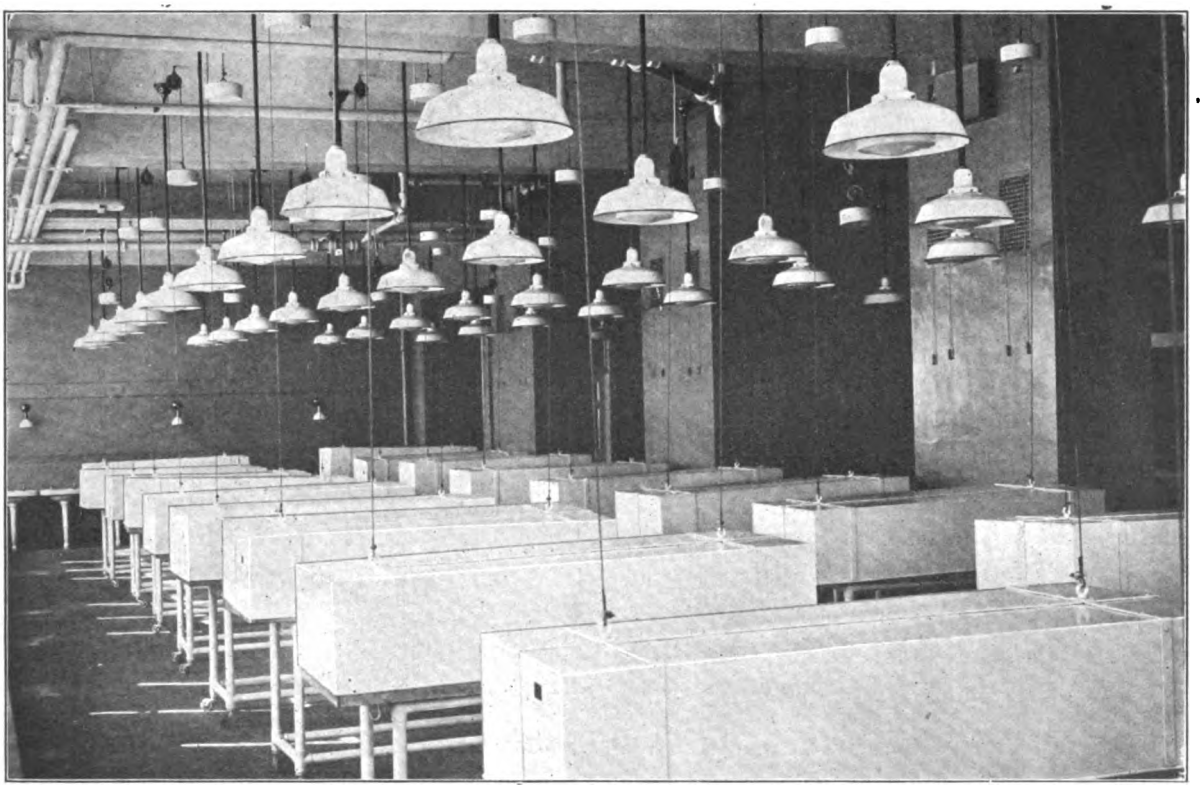

FIG. 1.—MEDICAL STUDENTS' DISSECTING ROOM

Twenty-five tables. Covers for preservation of cadavera in moist chamber. Copper cable with counterweights for raising covers. Illumination of each table, two 150 Watt nitrogen-filled mazda lamps in Benjamin diffuser shades

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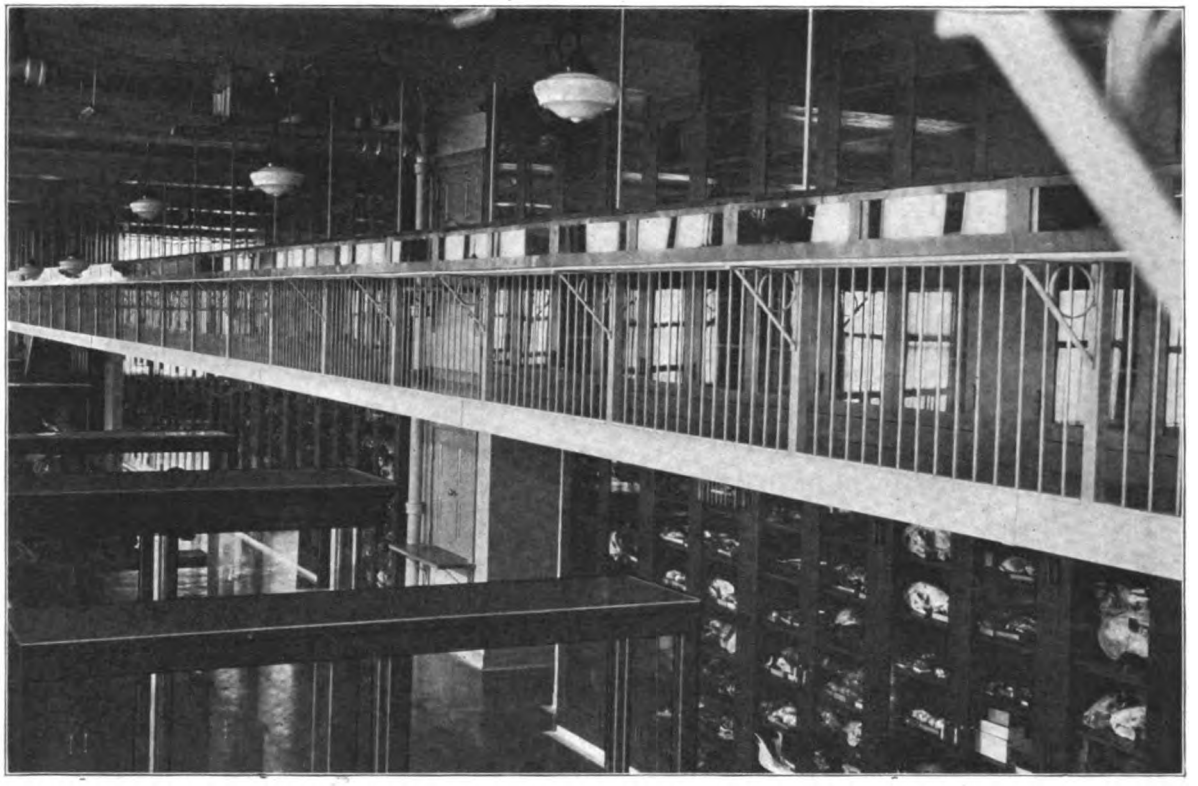

FIG. 2.—DETAIL OF HAMANN MUSEUM

Floor cases illustrating anthropoid anatomy, history, and embryology of Man; lower wall cases, comparative anatomy, human skulls; mezzanine, with railing cases and wall cases, human and comparative morbid anatomy, teratology. Dumb-waiter, basement to mezzanine. Illumination per unit, two 150 Watt nitrogen-filled mazda lamps in Macbeth-Evans monax glass fixture S-30

comparative, anthropological, and clinical applications, and neurology (neuro-anatomy) both gross and microscopic. Associated particularly with me in this work are Doctor Hamann and Doctor Ingalls, together with a number of junior assistants. Our method of administering the Laboratory gives the fullest possible co-ordinate independence to each of the three senior men.

In addition to caring for medical undergraduates the Laboratory furnishes instruction in anatomy to dental students. This work is in the charge of Doctor Ingalls, although I assist to the extent of giving the course in comparative dental anatomy.

Gross anatomy is taught during the first six months of the medical curriculum. The laboratory work consists of dissection of the entire body under the supervision of a corps of part-time demonstrators who are also engaged in clinical work. This is a mobile corps and each instructor is encouraged to specialize in the anatomy of his particular clinical field. Our plan is to develop electives in such special work as opportunity occurs and thereby provide for the more adequate study of particular phases of clinical anatomy. These electives are given during the first and second years of the course after the students have already attained a good grounding in the fundamentals.

In the dissecting course each instructor takes charge of a group of students and is encouraged to develop his own method of instruction. He is permitted two hours of quiz or tutorial work in the week and assists in the examination of all students. Thus we have all the benefits of the external examiner system. Three examinations are held during the course; they are all oral and the results of the first and second are immediately and fully published so that the student may check up his own progress. Each examination covers all laboratory and lecture work to date so that there is no pigeonholing of knowledge; we do not encourage credit for the dissection of a single part and our own students do not receive such credit.

The lecture course consists of three hours a week for six months. Half of it is given by Doctor Ingalls and half by myself. The lectures

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deal with general principles, are not based upon textbooks but upon modern research, and include general primate, especially anthropoid, anatomy, physical anthropology, the study of growth and differentiation, age changes, heredity, the influence of sex, hormonic co-operation and disharmony, a general study of the systems, gross and radiographic, and an introduction to surface and clinical anatomy preliminary to the course in applied anatomy later given under Doctor Hamann.

Neurology is concentrated in the first two months of the second year of study. It is intended to serve as a co-ordinating course preparatory to the study of physiology. At the same time it gives opportunity for the investigation of the anatomy of the new born. The practical course calls for the complete dissection of full-term foetus, especially of the nervous system, and for the study both gross and microscopic of the central and sympathetic nervous systems and the organs of special sense. The lecture course covers general animal behavior, the elements of psychology, the elementary or invertebrate nervous system, neuro-biotaxis, the phylogeny of the central nervous system especially of the cerebrum, and a somewhat detailed study of the mammalian cerebrum with special reference to the Primates. It also covers an applied study of the human nervous system, including paralyses, anaesthesias, ataxias, gaits, postures, and reflexes. The courses are given by Doctor Ingalls and myself with the aid of assistants.

In our presentation of anatomy we do not require student drawings except in the study of finer details of the central nervous system and sense organs. We do not encourage the use of note books, but we provide outlines. Nor do we ask for modelings of bones for there is the great Hamann Museum to draw upon for material. We do not regularly employ transverse sections since the stereoscopic method provides the same exercise with much greater profit. In all our lectures and in the routine work of the laboratory our greatest asset is the stereoscopic method of presentation. No specimens are taken into the lecture room but photographs are thrown in stereoscopic projection upon the screen. Each student is required to provide himself with the

FIG. 3.—DETAIL OF LIBRARY

Carries forty periodicals, the Weber collection of anatomical incunabula, a representative collection of monographs on comparative anatomy, physical and cultural anthropology, in addition to human anatomy. Illumination as in museum

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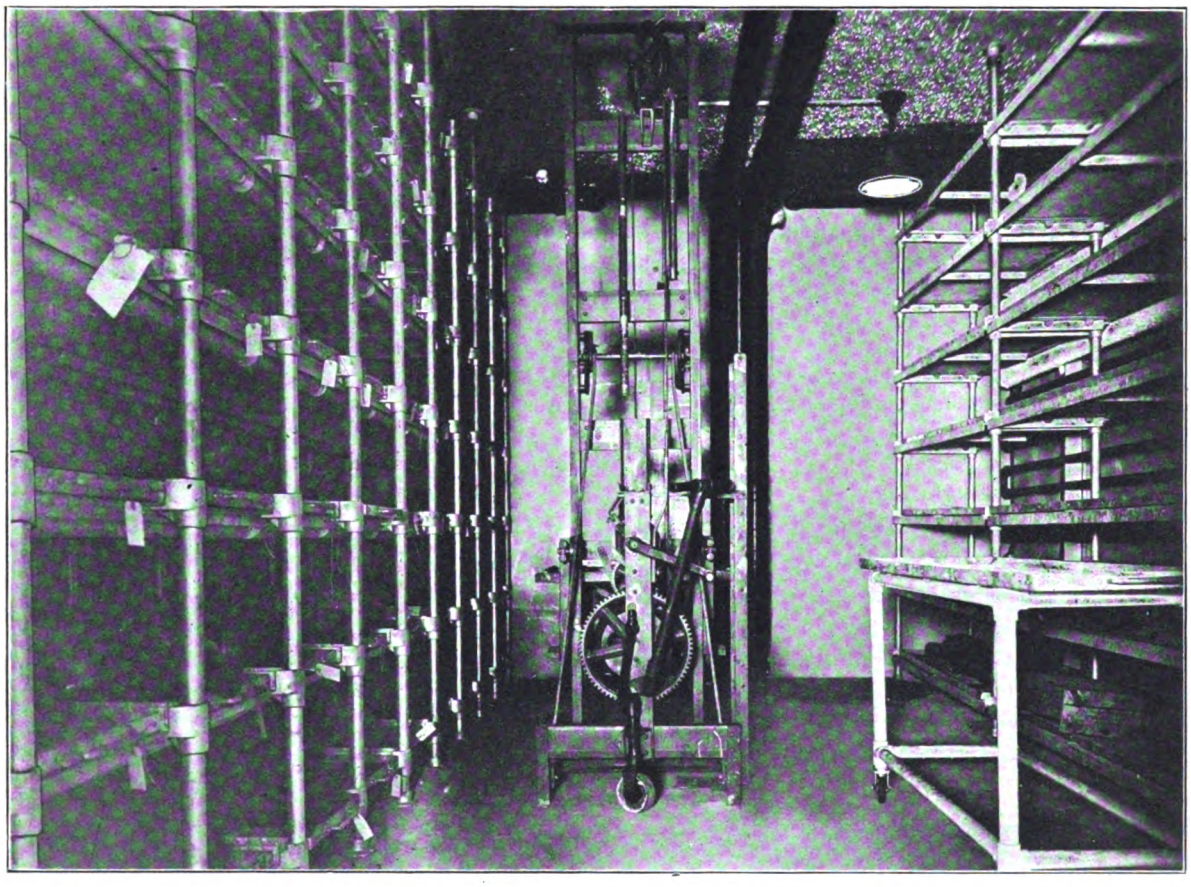

FIG. 4.—DETAIL OF CADAVER COOLER

Holds eighty-four cadavera upon zinc trays mounted on rollers and hoisted into place by volvator. Ammonia-brine cooling to 35° F.

proper spectacles. This method makes the finest details of structures readily visible in perspective to the entire class at once. We find that students can easily stand an hour's stereoscopic demonstration per day without the slightest eye strain and, further, that the method is equally available for the color-blind though not for the one-eyed student. All students are encouraged to dissect carefully and tidily so that stereoscopic photographs may be made of their work and used for further teaching and research. Students in special work such as the anatomy of the child are followed assiduously with the stereoscopic camera. In this way we are building up a great reference library of anatomical fact easily available for the quantitative study of age changes and variability. Each student who carries out this special work receives one copy of the stereoscopic photographs of his dissections properly labeled and described and therefore possesses a complete and permanent record of his investigations.

In addition to our own instructors, we have associated with us many investigators in special fields of clinical medicine whose names do not appear upon our staff. We are provided with a preparator, a mechanic, a photographer, a histological technical assistant (specially attached to the Laboratory of Anatomy), a museum assistant, and a secretary who also takes charge of the library and assists in anthropometry and statistics.

Briefly, the arrangement of teaching in the Anatomical Laboratory is the following: Gross anatomy, October to March, inclusive, during the first year; neurology, October to November during the second year; applied anatomy, twice weekly during the second and third years; elective courses at intervals during the first and second years.

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The teaching schedule and the composition of the staff permit each full-time instructor to devote at least six months of the calendar year to uninterrupted research.

II. RESEARCH

The Hamann Museum of Comparative Anthropology and Anatomy is the central feature of the laboratory and provides a unique opportunity for investigation and teaching alike, so thoroughly interwoven that they cannot be separated. It now includes about 1,000 complete human skeletons of known individuals with anthropometric, photographic, clinical, and personal data wherever available, mostly from our own hospitals. It also possesses some 600 mammalian skeletons, many more mammalian skulls, and a good number of complete animals. The brains of the individuals are preserved and there is a collection of about 600 human embryos, the latter under the special charge of Doctor Ingalls. The considerable collection of gross pathological and clinical material is taken charge of by Doctor Hallisy under the direction of Doctor Hamann and myself.

From the Hamann Museum are drawn the specimens used in teaching and the gross pathology collection provides the basis for the course in applied anatomy given by Doctor Hamann twice a week to second- and third-year students.

The subjects of research naturally vary with the changing composition of the staff. In the anatomical laboratory researches are now in progress in embryology, physical anthropology, population characters, age changes, heredity, normal and pathological structure of the heart, a quantitative study of nasal anatomy, a quantitative investigation of variability of the muscular systems of hand and foot, and the orthopedics of the vertebral column. The most significant researches permitted by the unique character of the Hamann Museum are those dealing with the population of this continent,

FIG. 5.—DETAIL OF SKELETON ROOM

Racks ten tiers high. Standard boxes each contain one complete human skeleton with all bones marked permanently with number of cadaver. Files in record room. Capacity of this store, 1,080 skeletons

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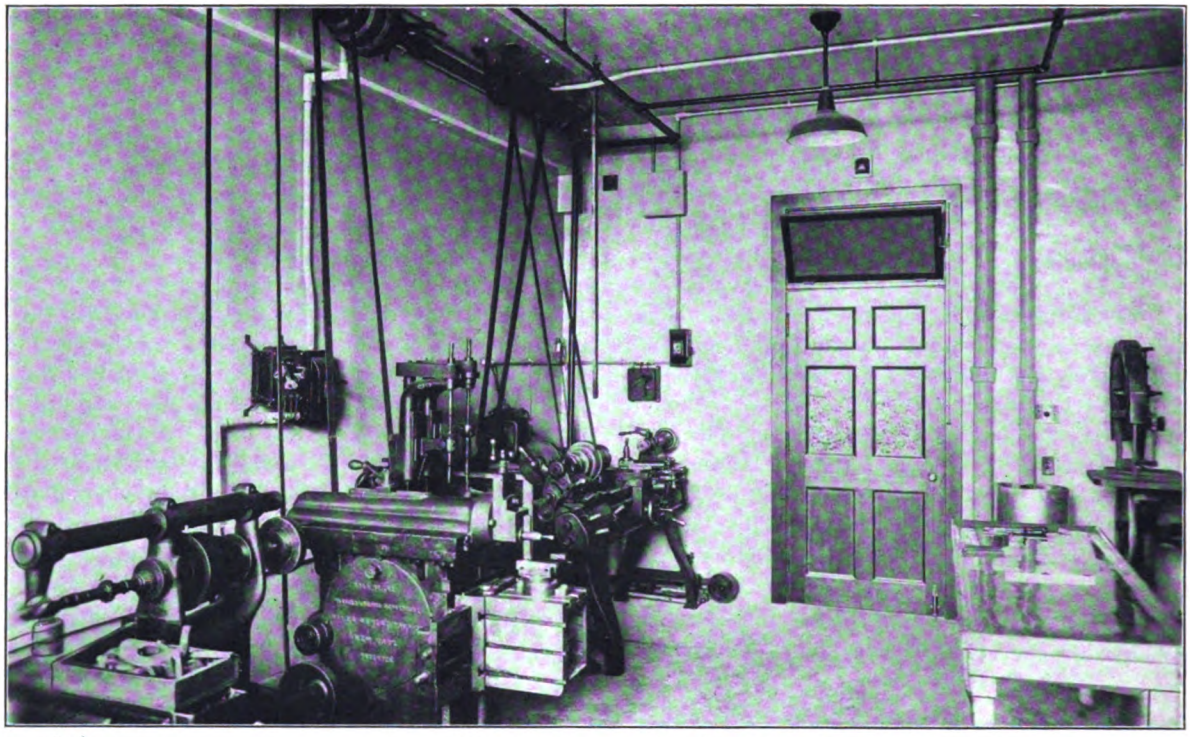

FIG. 6.—DETAIL OF SHOP

Lathe, shaper, miller, drill presses, band-saw, etc., concentrated into minimum working space upon reinforced floor

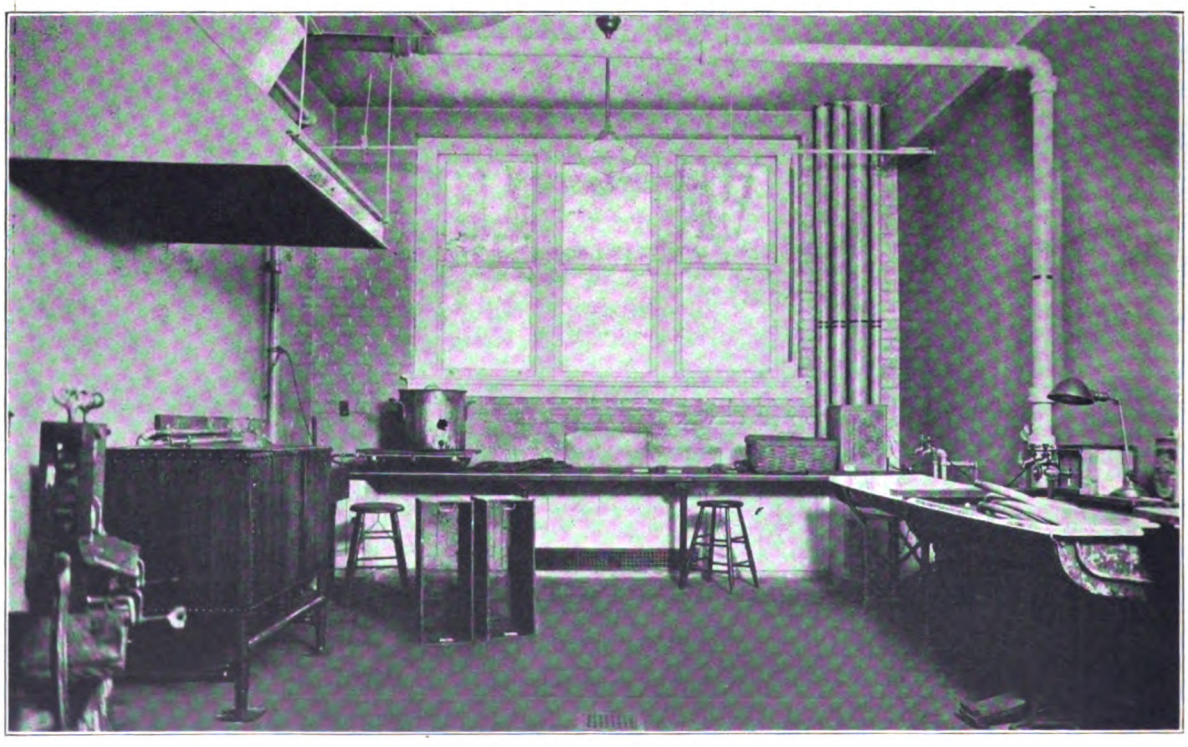

FIG. 7.—MACERATING ROOM

On extreme left is washing machine for cadaver cloths. Then in order to the right, successively, are the following: macerator with its hood, simmering kettle (on bench), cadaver steaming crates from macerator (upturned on floor), skeleton washing sinks, motor brush for cleaning bones (above sink)

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both White and Negroid, as represented in Cleveland.

In connection with research it should be emphasized that the trustees realize fully how impotent even the best type of research is apt to be without adequate presentation. To an altogether unusual degree, therefore, funds are provided for publication, plates, and illustrations. We know that scientific journals in anatomy cannot be self-supporting. Until such time as the journals do have adequate financial support it is the responsibility of anatomical institutes to subsidize them. It would be a short-sighted policy to permit the expenditure of thousands of dollars for research and then grudge the few hundreds necessary for its proper presentation.

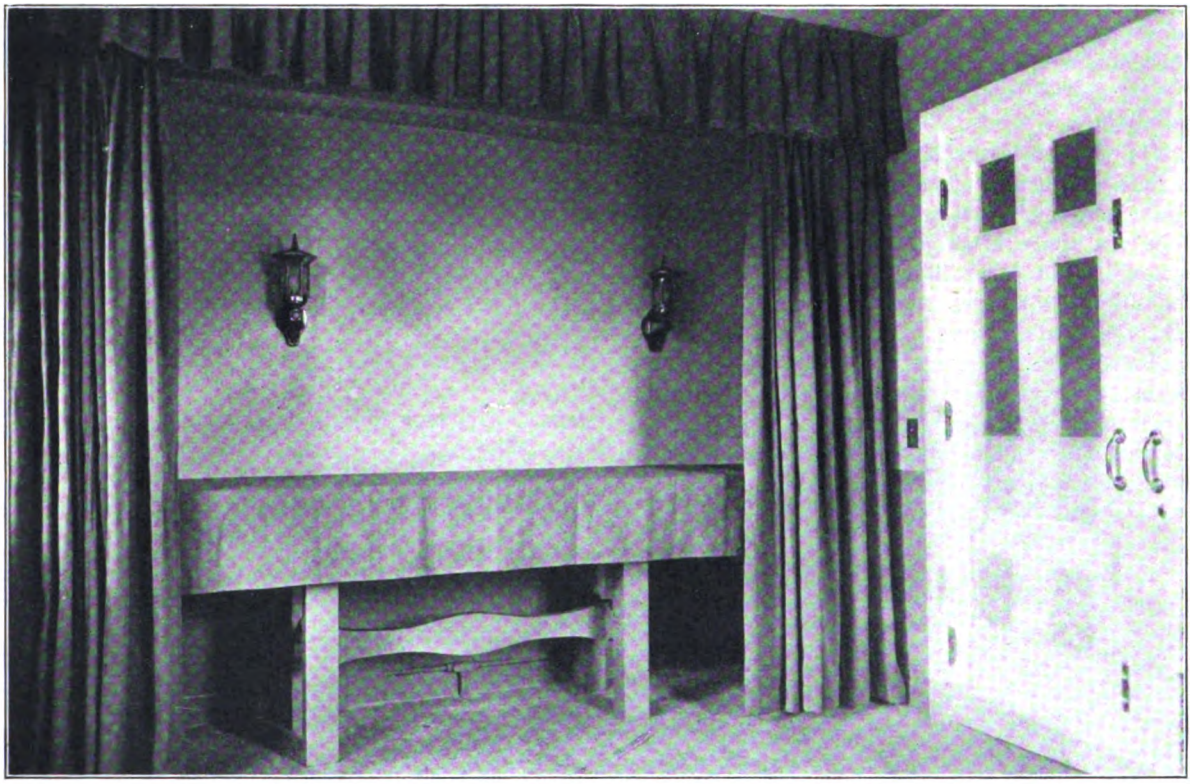

FIG. 8.—CHAPEL

For use of relatives viewing body and for burial services

III. DEPARTMENTAL INDUSTRIES

The unique opportunities offered in Cleveland for the development of anatomy have necessarily encouraged a sense of responsibility to national scientific effort.

In the first place other institutions are supplied upon request with photographs flat and stereoscopic, radiograms, and lantern slides of our material. From our extensive files data, especially of the anthropological type, are forwarded to workers in other centers for use in special lines of research. It is of course stipulated that in publication the source of these observations should be acknowledged.

Secondly, special facilities are provided for the worker who is unable to come to Cleveland for a prolonged period of research. After obtaining intensive training in his particular line he may have sent to him photographs of the specimens he desires to study more particularly and copies of such of our routine observations and measurements as are required for the elaboration of his investigation.

Thirdly, instruments and apparatus are manufactured for other institutions and supplied on a cost basis, covering material, labor, and overhead.

IV. DESCRIPTION OF NEW BUILDING

The Anatomical Laboratory occupies the basement and first floor of the east side of the new

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building. The total floor space comprises about 15,800 square feet. The first floor in the east wing is occupied by the museum, library, and medical students' dissecting room. Closely adjacent are the photographic suite and preparator's room. Then follows a series of ten rooms each of one unit, occupied by staff, records, and technique. At the end of the east wing in the basement are the receiving and cadaver storage rooms. Then come casting room, brain and foetus storage rooms, shop, skeleton stores, macerating room, fume chamber suite, X-ray room, and, in the main part of the building, dental students' dissecting room. The anatomical amphitheater seats 140 and occupies space on both floors.

The special features of the building are the following:

(1) The Hamann Museum (160 ft. by 30 ft.), with a mezzanine floor, is equipped with specially designed dust-proof cases. On the main floor the space is subdivided into study alcoves by exhibition cases illustrating the anatomy of the anthropoid apes and the history and general features of man. Ranged along the west wall are cases carrying the collection of human skulls, embryological and neurological reconstructions, and comparative anatomy. In the mezzanine are the collections of teratology and gross morbid anatomy. A dumb-waiter carries material between the basement and both floors of the museum.

(2) In the library is housed, and to some extent displayed, the Weber collection of anatomical incunabula and other rare books.

(3) The amphitheater is equipped with the usual forms of transparent and opaque projection, and in addition with stereoscopic projection, a method which has been developed for anatomy in this laboratory.

(4) The tables in the dissecting rooms are provided with covers which, in our experience, furnish the most efficient protection for cadavera and give a neat and decorous appearance to a laboratory which is apt to be somewhat repellent.

(5) The great skeleton stacks provide room for about 1,500 complete skeletons, the skulls of which are preserved in the museum.

(6) The cadaver storage rooms are chilled with brine and each cadaver lies free upon its tray so that it can be referred to before dissection as easily as its skeleton may be studied after maceration. Space is provided for eighty cadavera and thirty-six large mammals.

(7) The macerator is built of copper and brass throughout and maceration is carried on by a specially devised live-steam method which obviates the necessity of degreasing.

(8) The fume-chamber suite provides small rooms for the use of aqua regia, carbon disulphide, and gasoline.

(9) The mortuary chapel is an essential part of the laboratory. In it burial services may be held and to it relatives are taken who come to claim the body of the deceased.

V. STAFF

Professional

One professor (full-time); one associate professor (full-time); one professor (part-time, in charge of clinical anatomy); and a varying number of associates, instructors, fellows, and demonstrators, mostly part-time. (At present one is full-time and seven are part-time.)

Technical

One preparator; one mechanic; one secretary and librarian; one research assistant in histological technique and reconstruction; one museum assistant.

The photography is at present under the charge of a full-time fellow on the professional staff.

The present staff appointments have been made with the conviction that the foremost duty of an anatomical laboratory, apart from the advancement of science, is to contribute to the equipment of medical practitioners of a high grade. Our students are therefore given a broad and intensive course of instruction and after graduation are welcomed back as part-time instructors to enable them to round out their own knowledge and to keep constantly before the students the vivifying and practical clinical aspects of their study. We realize fully the urgent need for training full-time anatomists, but we also recognize that our opportunity in this respect is limited until there are again offered such prospects, emoluments, and standing as will justify us in encouraging younger men to take up an anatomical career as their life work.

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UNIVERSITY OF LEIDEN
DEPARTMENT OF ANATOMY

BY

J. A. J. BARGE, DIRECTOR
PROFESSOR OF ANATOMY AND EMBRYOLOGY

HISTORY

The Anatomical Laboratory opened on October 2, 1923, is the fourth in the history of the University of Leiden. Very soon after the founding of the University in 1575 it was decided to institute a separate professor's chair for anatomy and in 1589 Pieter Pauw (Petrus Pavius) gave his first lecture as official anatomist. The first anatomical laboratory of Leiden, together with the library, was installed in a church specially rebuilt for this purpose. For more than two centuries some of the most famous anatomists of Leiden University such as Pauw, Van Horne, Nuck, Bidloo, Rau, and B. S. and F. B. Albinus lectured in this building and by their persevering labors laid the basis of the justly famous anatomy collection of the eighteenth century. At the beginning of the nineteenth century the rapid growth of the collection called for a new laboratory and it was decided to turn the whole building over to the library and to erect a new structure principally for anatomy adjoining it. This building served from 1822 to 1865, when a whole new series of laboratories was erected for the natural sciences, uniting chemistry and physics and lodging anatomy in an entirely independent wing.

FIG. 1.—DEPARTMENT OF ANATOMY, UNIVERSITY OF LEIDEN

Shortly after the definite separation of anatomy and physiology an independent laboratory was installed for the first Leiden professor of

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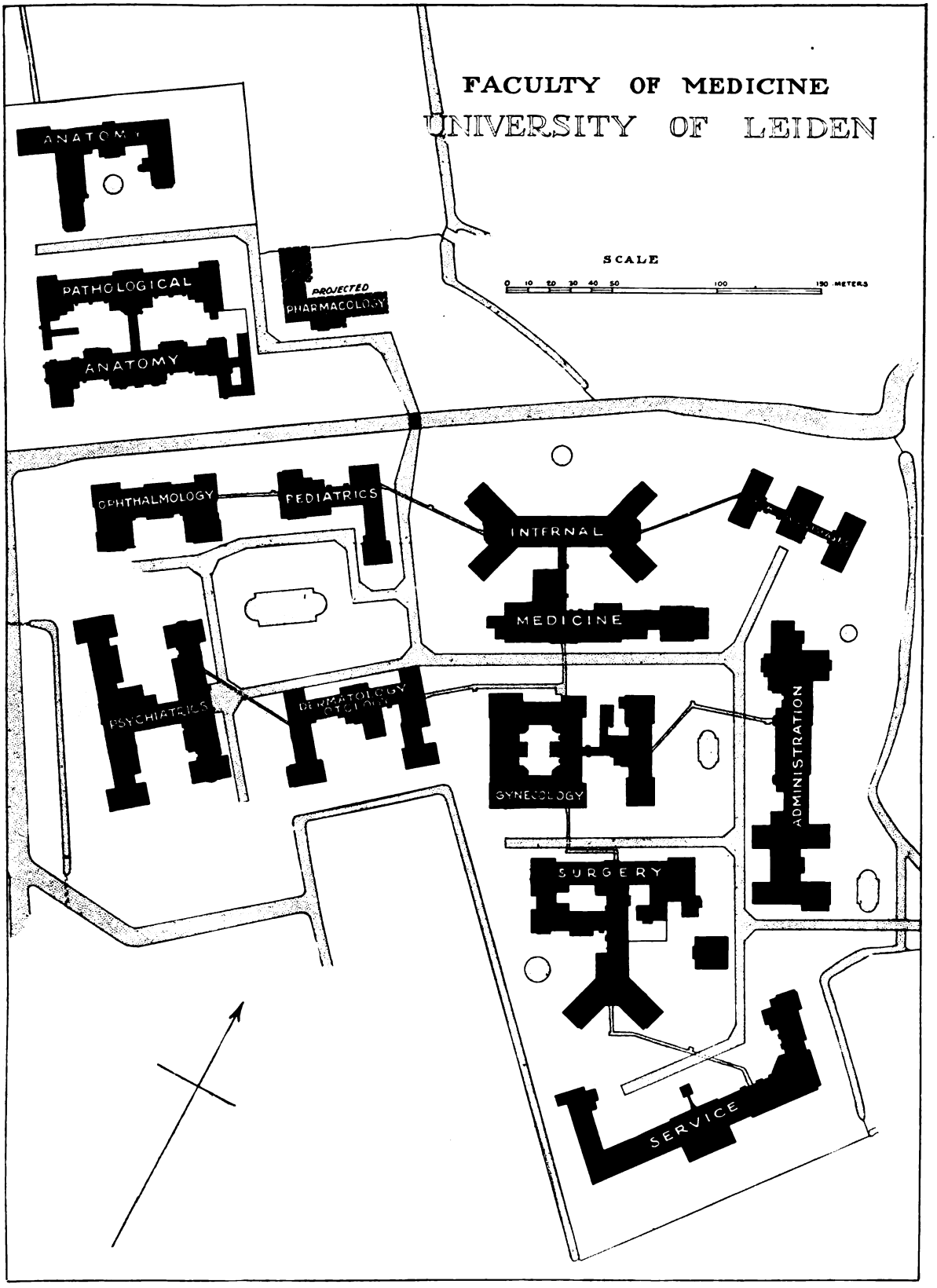

FIG. 2

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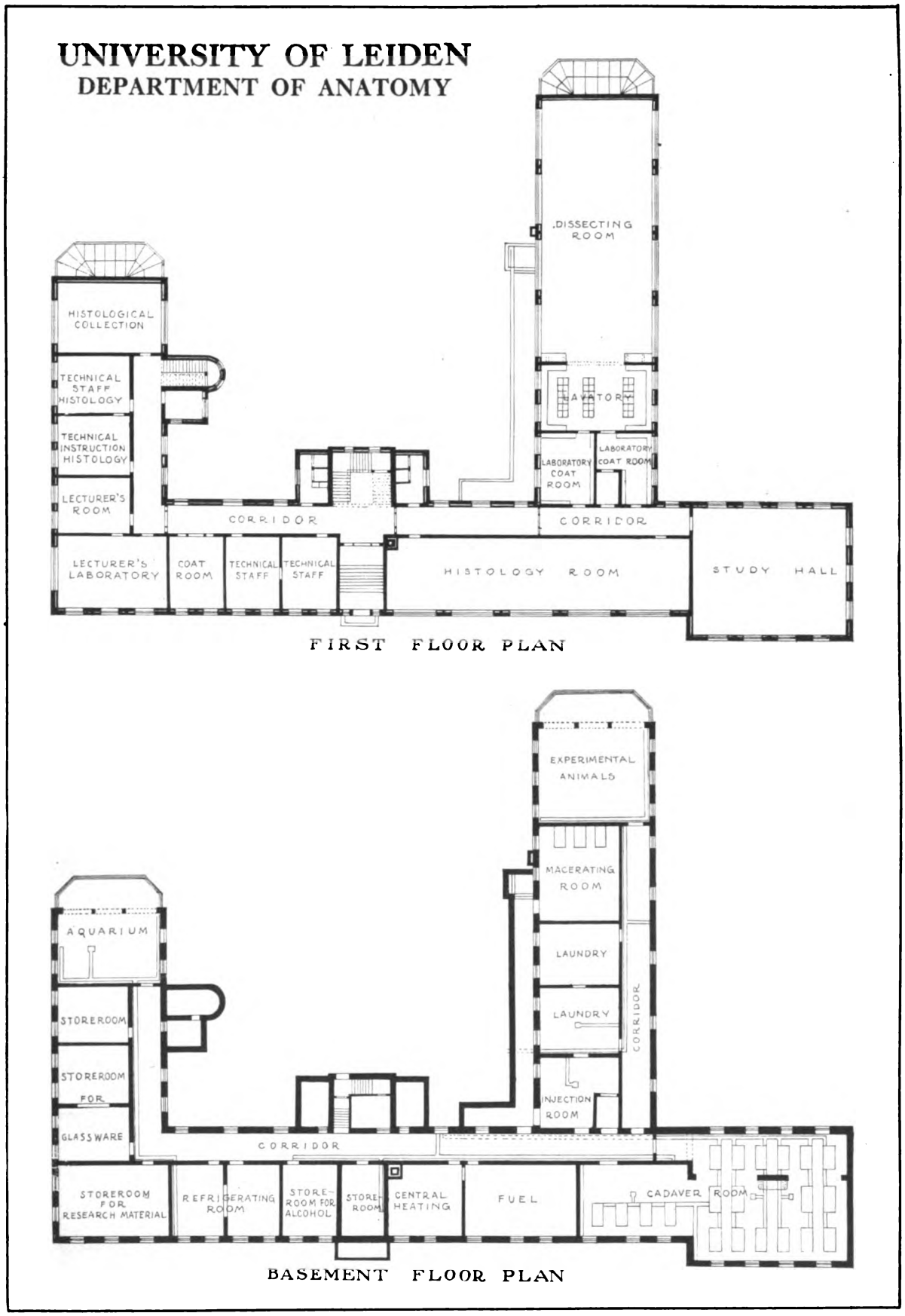

FIG. 3

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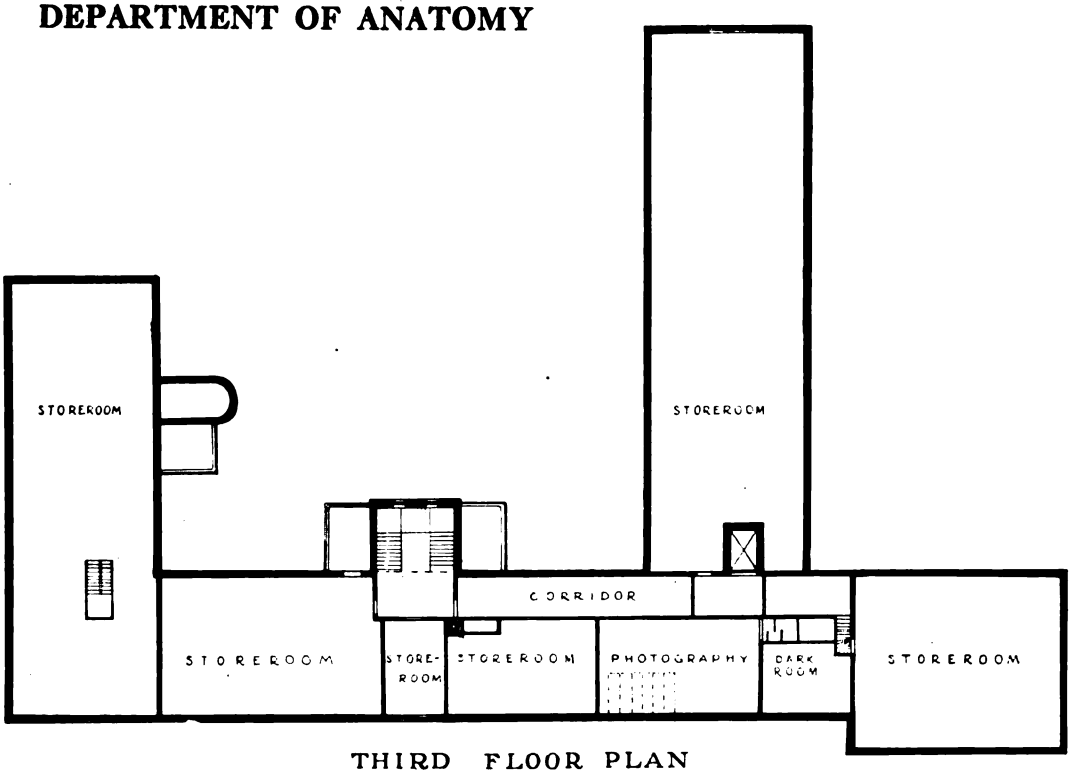
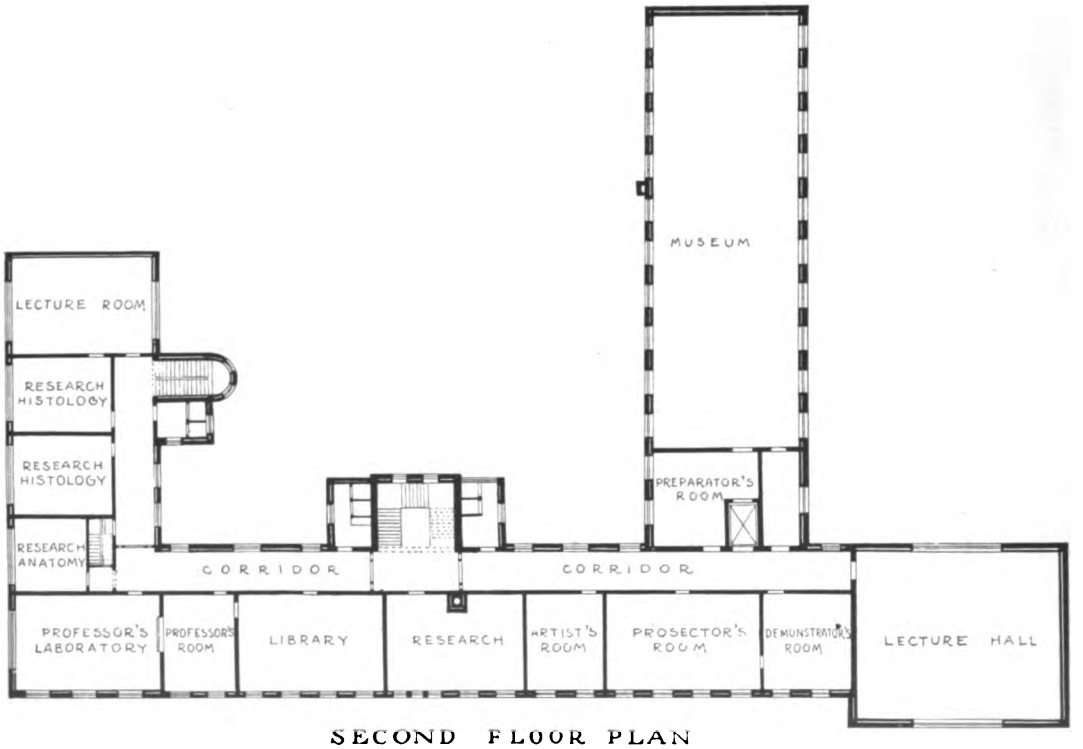
UNIVERSITY OF LEIDEN
DEPARTMENT OF ANATOMY



THIRD FLOOR PLAN



SECOND FLOOR PLAN

FIG. 4

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physiology, Heinsius. This laboratory, built in 1865, became inadequate when the separation of histology from physiology and its incorporation with anatomy brought about a rapid increase in the number of students. In 1912 it was decided to bring together the entire medical faculty, with all the clinics and laboratories, in a series of buildings on one plot of ground. A group of thirteen buildings, in which with a few exceptions all branches of the medical sciences could be brought together (Fig. 2), was planned for a site of about 170,000 M². The world war and the economic complications following it delayed this comprehensive plan, so that for one reason or another construction had to be stopped and completion postponed.

The independence of the Anatomy Laboratory and the facility with which it could be constructed as an entirely separate unit had most to do with the decision to complete this laboratory, with the result that it was opened for use on October 2, 1923.

THE NEW LABORATORY

In the construction of the new laboratory a special effort was made to provide facilities for a long period in the future. Besides satisfying present needs, it had also to be kept in mind that further development and differentiation of the morphologic branches will require additional accommodations.

Up to the present time anatomical instruction at Leiden University has been in charge of a professor of anatomy and embryology, and a lecturer in histology and microscopic anatomy. Both are installed in the new laboratory and in such a manner that, with the exception of a common lecture hall, they have separate workrooms.

In the construction of the laboratory an attempt has been made to provide separate quarters for instruction in scientific research, in order to assure as far as possible the quiet necessary for the latter. The result achieved has been satisfactory in this respect.

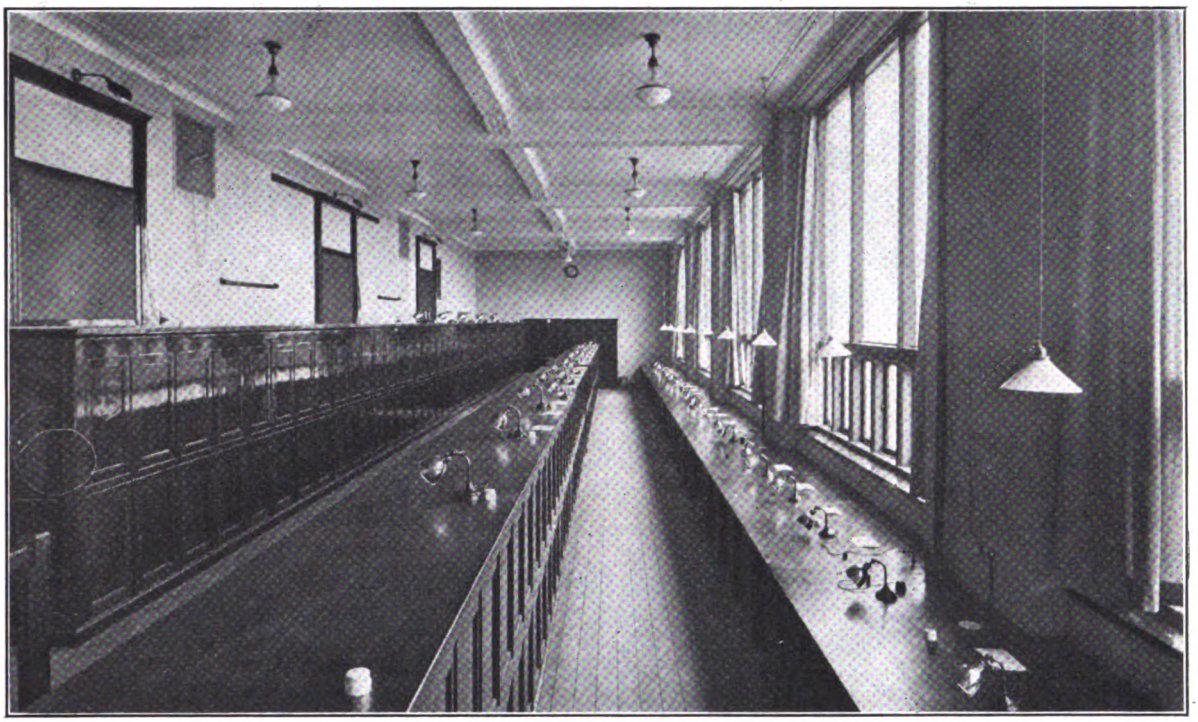

FIG. 5.—HALL FOR PRACTICAL WORK IN HISTOLOGY

The front of the building (Fig. 1) is seventy-two meters long. Two wings extend from the back, the one on the left measuring 23 meters and the one on the right 37 meters.

Including the basement, which is mostly above the ground, the building has three stories and an attic. The rooms for scientific research are located to the left of the main entrance, those for the Histology Department being situated in the left wing. To the right of the main entrance are rooms for instruction. An electric lift is

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FIG. 6.—STUDY HALL

conveniently situated in relation to the cadaver storage room, dissecting room, museum, and lecture hall which are situated on different floors.

The central heating plant is in the right hand section of the basement (Fig. 3), together with room for fuel storage. Next to this is a spacious and airy room with twenty large tanks of reinforced concrete each of which can easily hold four bodies. Then come the injection room for disinfecting and preserving bodies, a laundry with a drying room, and a room for maceration and the degreasing of bones.

In the left half of the basement is the storeroom for alcohol and other preserving fluids, a cold room with a large refrigerator for cadavers and an electric ribbon-saw for the preparation of sections. Next comes a room for the storing of research material.

At the extremity of both wings are facilities for keeping experimental animals, on the left an aquarium and on the right quarters for housing warm-blooded animals.

On the first floor (Fig. 3) to the right of the main entrance there is a large room for practical work in histology and microscopic anatomy (Fig. 5). The large windows face an open landscape to the northwest, so that light reaches all parts of the room. The work tables are placed in three rows, each higher than the other, so that the light falls freely on the mirror of the microscope. The room, 6½ M. x 27 M., is finished throughout in pitch-pine and has seating accommodations for seventy students, and cupboards and drawers for 170 students, where microscopes and other instruments can be kept under lock and key. Every work table has its own electric light.

Next to the room for microscopy is the study hall (Fig. 6), for students (14 M. x 11½ M.). The reading tables are supplied with the usual textbooks and atlases and a continually varying collection of monographs on general biology. There is also a large collection of plaster casts of anatomical preparations (principally from the atelier of F. J. Steger, Leipzig), skeletons and bones for the study of osteology, five revolving stereoscopes in which the plates of the Edinburgh stereoscopic atlas are systematically arranged, together with a number of glass cases, in which frequently changed preparations related to subjects dealt with at the lectures are exhibited.

In the right wing the whole of the first floor is taken up by the large dissecting room (Figs. 3 and 7). From the corridor entrance is had to a pair of front rooms with metal lockers in which the students keep their laboratory coats and in-

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struments. The lavatory is next, with accommodation for thirty-six students engaged in practical work. The dissecting room measures 24 M. x 10 M. and is splendidly lighted from both sides by large plate glass windows. The artificial lighting is on the semi-indirect system, which has the great advantage of preventing fatiguing lights from striking the eyes of the students and strong shadows from falling on their work. Instead, an even, soft, and very clear light is diffused. One objection to this system is that all the lamps in the room must be turned on before the light is really good, but this is not important, as work is done only during certain hours when the whole room is occupied and all the lights are necessary. The total strength of the artificial light amounts to 13,000 candle-power.

The dissecting tables consist of a simple iron frame with a leaf of polished freestone which is very easy to clean. There are altogether thirty-two tables, at which 112 students can be comfortably seated. The number of tables can be easily increased.

Next to the main entrance in the left half of the building is the workroom for the technical staff and adjoining it the cloakroom for the students. The whole of the left wing on the first floor is used for histology. The lecturer's room is there and also his private laboratory. Adjoining it is a room where small groups of students receive instruction in histological technique (fixation, including methods, cutting with the microtome, staining of the sections, etc.). Next comes a room for the technical staff of histology and at the end of the left wing there is a room for the histological collection.

The right half of the second floor contains the large lecture hall in addition to the workrooms for the prosector, the demonstrators, the students engaged in research work, and the artist. The lecture hall (14 M. x 11½ M.) is finished entirely in pitch-pine and teakwood. It will easily accommodate 176 students and this number can be raised to 200 and even more without much inconvenience. The light streams in from two sides through the large windows and the room is remarkable for its excellent acoustics.

The number of students is much too large to make a demonstration on a cadaver during the lecture really profitable, but every opportunity for this is given in the dissecting room. The lecture hall has therefore been fitted up as an ordinary auditorium with raised seats as in a theater, with a large epidiascope in the middle. In front of the professor's desk is a very large table, on which a number of preparations can be placed for examination at the end of the lecture.

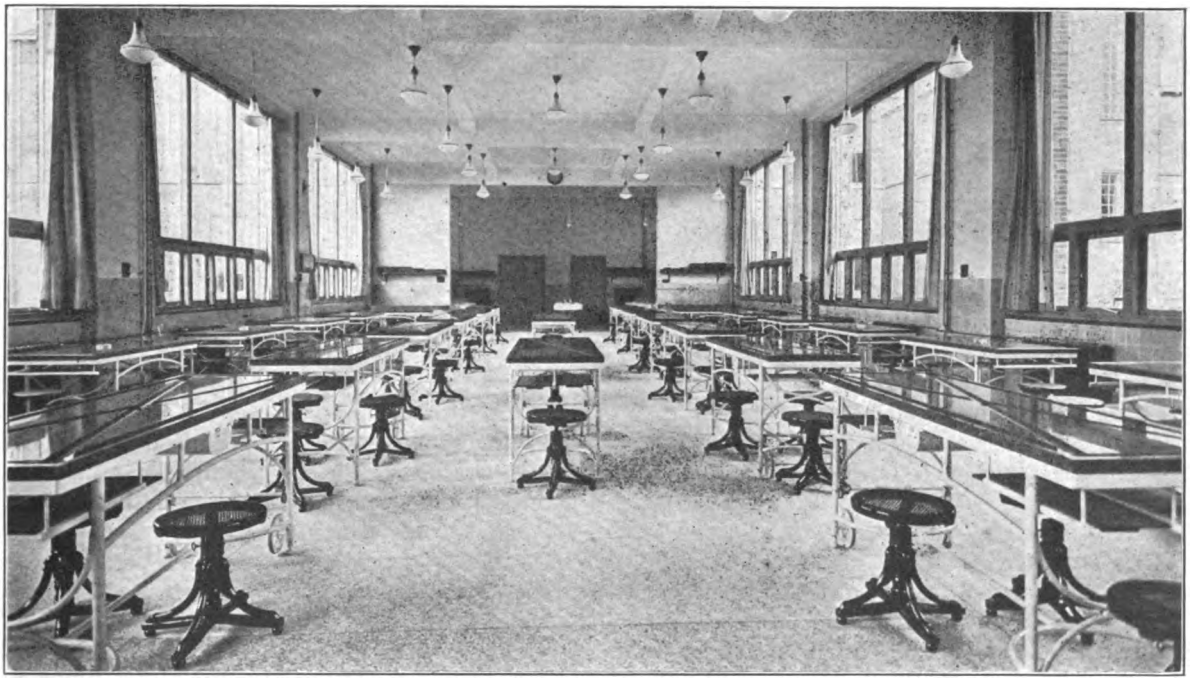

FIG. 7.—DISSECTING ROOM

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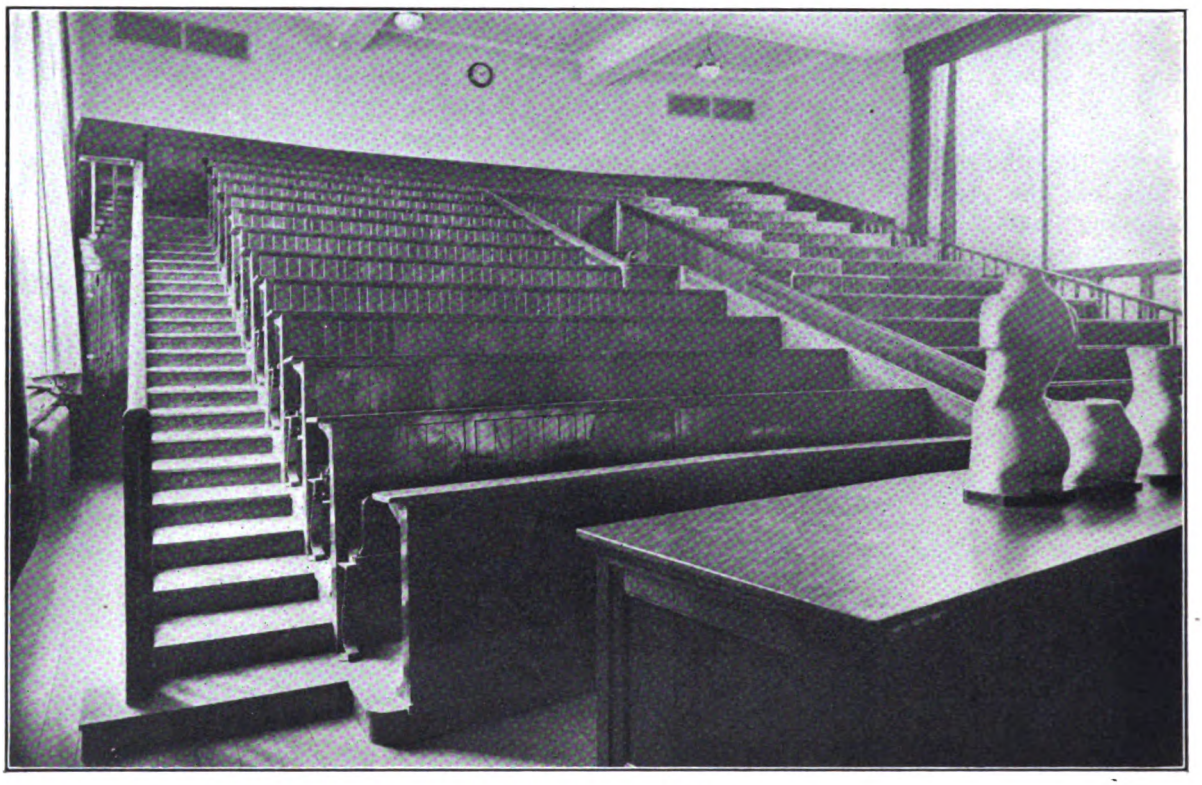

FIG. 8.—LECTURE HALL

The projection screen, the drawing boards, and the arrangements for hanging up drawings are all combined in a practical way.

Most of the second floor of the right wing is fitted up as a museum (Fig. 9), which occupies a room 30 M. x 10 M. and contains, exhibited in eighteen large glass cases, a collection of embryological wax models and embryological preparations, and a large number of systematical and topographical preparations for instruction. The museum also has an extraordinarily rich collection of teratological subjects for both man and animals, a number of important variations of different organs and systems, a collection of skeletons of the different races, an extensive collection of skulls of anthropological importance, together with a number of plaster casts of various remains of prehistoric man. There is also a historical collection in the museum. In a large cupboard, once belonging to B. S. Albinus, a number of well-preserved preparations are kept, dating from the period of the so-called anatomy cabinets. This affords opportunity to admire the technical skill of men like Rau, Nuck, Albinus, Bonn, and others and to note from first hand observation the methods employed at that time for presenting anatomical details.

In the left half of the second floor are grouped the library and the private room of the professor of anatomy and embryology, to which there is also attached a room for research. The left wing has a number of rooms for the demonstrator and the scientific workers in histology and also at the end a small lecture room.

The attic (Fig. 4) has extensive storage space; a room containing a large collection of Dutch skulls, the property of the Dutch Anthropological Society; and a large photographic studio with an installation for microphotography, and drawing apparatus. A part of the roof is fitted up for the bleaching of bones.

INSTRUCTION

Instruction in anatomy, embryology, and histology is given entirely in the new laboratory. The courses in anatomy and embryology are given by the professor, and those in histology and microscopic anatomy by a lecturer.

In the anatomy instruction all possible emphasis is laid on the practical work in the dissecting room, since only a prolonged study of what is being dissected by the student himself can give the proper insight into anatomical relations.

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The students receive instruction in anatomy for two years. The practical work is so divided that the first year is devoted to muscles and joints, with perhaps some work on the topography of the limbs. The second year's work deals particularly with the brain, and preferably with the intestines, the situs viscerum, and with the topography of the head, neck, and limbs.

The dissecting is performed very methodically under ample directions prepared for the purpose by Professor Barge. Experience has shown that without definite directions and without an adequate and permanent staff of demonstrators the various dissections will be done too poorly and too unsystematically to give the results that should be expected, considering the value of the material and the time spent on it.

The function of the demonstrator in the dissection room is limited to seeing that the work is done according to the prescribed method and that the students gain sufficient knowledge of the organs they are dissecting. Of course correction is given where needed and when the student departs from the methods prescribed the demonstrator intervenes, but on the whole the aim is to let the student do his own work as far as possible.

The dissecting room is open in the afternoon from half past one to four o'clock. The staff of demonstrators is insufficient to permit practical work during other hours of the day, for, as has already been remarked, work without supervision is not approved.

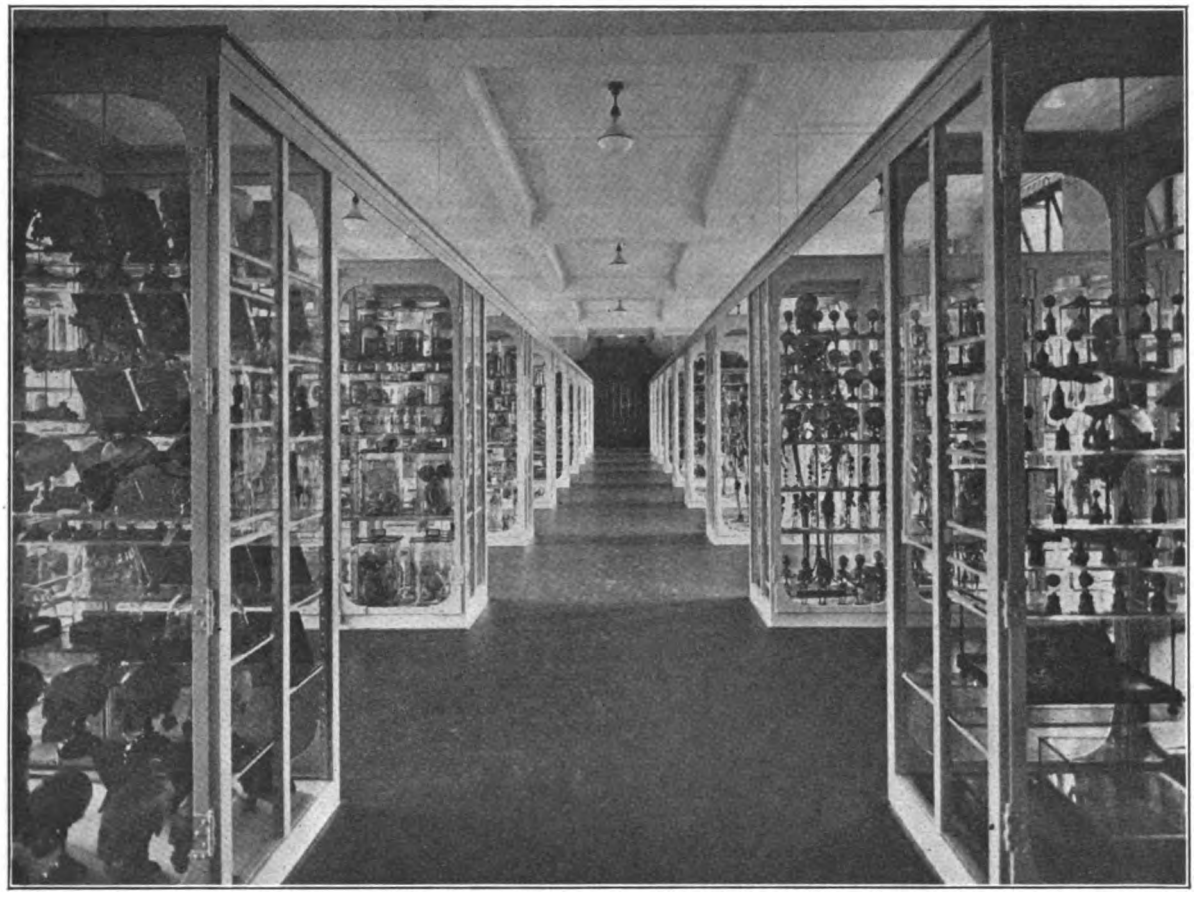

FIG. 9.—MUSEUM

The theoretical instruction consists of three hours of systematic anatomy, one hour of topographic anatomy, and one hour of embryology a week. The embryology lectures deal chiefly with progeny and blastogeny, together with the development of the external shape of the body and the relation between mother and child. Organogeny is usually dealt with in the systematic anatomy lectures. Instruction in embryology is purely theoretical. For the students who have finished their clinical studies and have

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only to take the practical examination to become physicians an hour of applied anatomy is given once a week, with consent of the professor of surgery.

Anthropology is not taught as an independent subject. Whenever there is time for it, the professor of anatomy gives a series of lectures on general anthropology or prehistoric man.

Instruction in histology and microscopic anatomy extends over three years. In the first year physics, chemistry, zoology, and botany, as well as cytology and general histology, are taught, while in both of the following years microscopic anatomy is included in addition to anatomy, physiology, and general pathology. In the first two years the instruction is both practical and theoretical, while in the third year it is theoretical only. Besides the instruction he gives to medical students, the lecturer in histology gives a course in comparative histology for the students of biology in the zoological laboratory of the university.

In the practical exercises the microscopical preparations are furnished to the students in a finished state, so that they can give all their time to their study. Histological technic is not a compulsory subject, though special instruction is given to small groups of students who desire it.

The professor of anatomy and embryology and the lecturer in histology both deal with certain divisions of their science in a special way as "capita selecta." This includes lectures on general heredity, experimental biology, and teratology.

RESEARCH

The research work done during the last years in the Department of Anatomy and Embryology have had special reference to comparative myology, comparative anatomy and embryology of the lip, comparative anatomy of the sutura metopica, and to different subjects of teratological nature.

In the histological department work was done on the histological changes in muscular tissue under influence of freezing, on changes in the cytoarchitectony of the cortex of the brain in rodents under the influence of varying conditions, and extensive experiments on the development of the hen's egg in vitro were made.

STAFF

The scientific staff attached to the laboratory is comparatively limited and is constituted as follows:

Prof. dr. J. A. J. Barge, professor of anatomy and embryology
Dr. Ae B. Droogleever Fortuyn, lecturer in histology
Dr. P. A. Dietz, prosector in anatomy
Dr. J. P. Vogelaar, first demonstrator in histology
Dr. H. W. Lubberhuizen, first demonstrator in anatomy
P. J. Van der Schaar, demonstrator in anatomy
J. Laeyendecker, demonstrator in anatomy
H. W. Julius, demonstrator in histology
B. Th. de Hey, artist

The technical staff consists of one custos, who has supervision of building and collections; one technical assistant for histology, one mechanic to make apparatus, one employee for the central heating plant, and one charwoman.

EXPENDITURES

Annual cost of the Anatomical Laboratory, excluding interest on cost of building and maintenance of building:

	Florins
Salaries of the scientific and technical staff	39,750
Expenses for general service in the interest of instruction and scientific research	10,000
Maintenance of furniture	250
Total	50,000

Received for Publication June 9, 1924

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DIE DR. SENCKENBERGISCHE ANATOMIE
DER
UNIVERSITÄT FRANKFURT AM MAIN

VON
DR. MED. HANS BLUNTSCHLI
PROFESSOR DER ANATOMIE

EINLEITUNG

Die Universität in Frankfurt am Main ist eine der jüngsten Universitäten Deutschlands. Ihre Eröffnung erfolgte am 18. Oktober 1914, also im dritten Monat des unheilvollen Weltkrieges. Doch ist sie nur bei oberflächlicher Betrachtung ein Kind der schweren Kriegszeit. Sie verdankt ihre Entstehung vielmehr einer eigenartigen Geschichte, nämlich dem langdauernden, allmählichen Ausbau einer ganzen Reihe von selbständigen Institutionen, die sich alle auf verschiedenen Teilgebieten sowohl die Förderung der Wissenschaft, als auch die Bereicherung des geistigen Lebens in der altberühmten Handelsstadt zum Ziel gesetzt hatten. Sie waren meist durch Stiftungen opferfreudiger Bürger entstan-

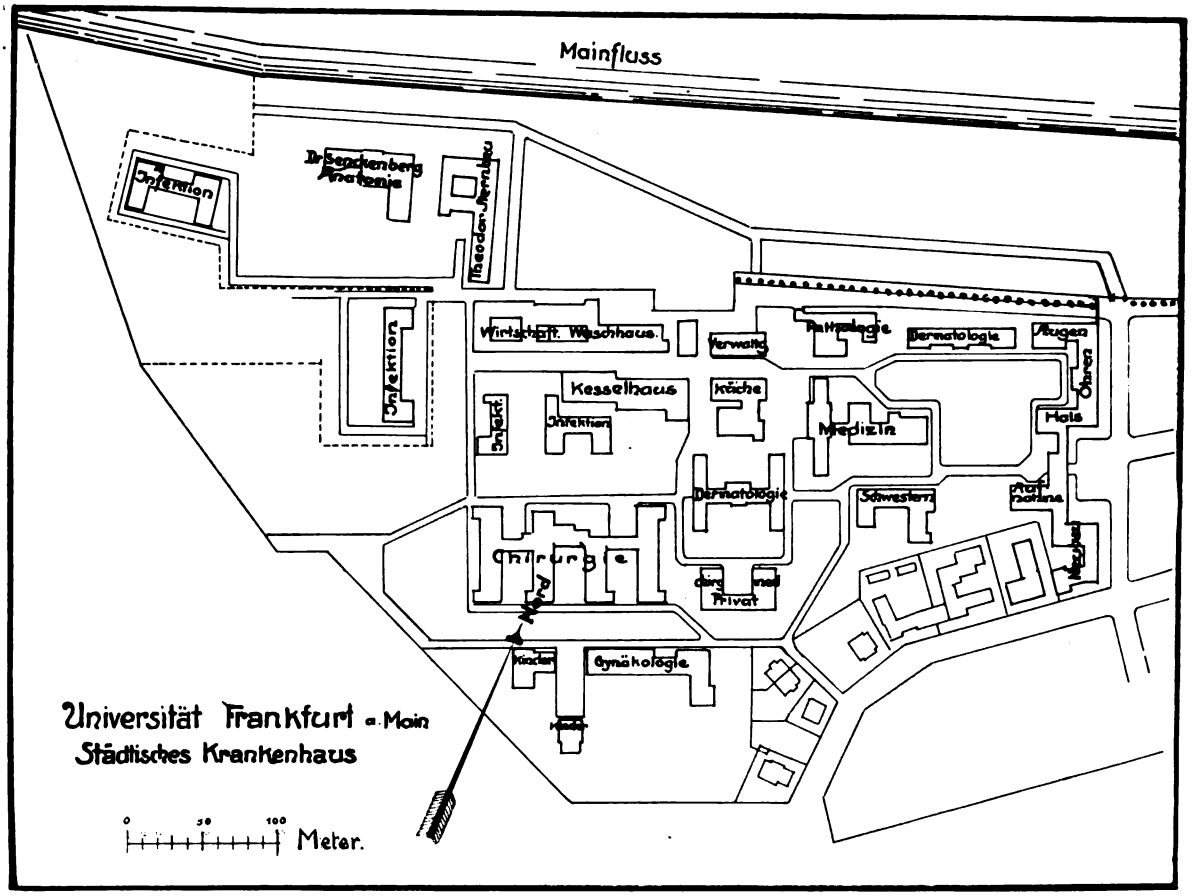

FIG. 1

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FIG. 2.—HAUPTFRONT MIT ZENTRALBAU UND WISSENSCHAFTLICHEM FLÜGEL

den, wurden später zumeist durch grössere Gesellschaften von strebenden Bürgern getragen und fanden durch eine freiheitlich gesinnte Stadtverwaltung stille Förderung. Jene Institutionen verwalteten sich selbst, suchten ihre Aufgaben nicht grösser zu stellen, als den vorhandenen Kräften entsprach und entwickelten sich in der Freiheit, abseits von bürokratischer Kleinlichkeit, getragen durch das Wohlwollen einer immer interessierten Bürgerschaft, die vielfach durch neue Stiftungen den Aufgabenkreis zu erweitern erlaubte, recht erfreulich zu grösser Leistungsfähigkeit. Die weitblickende Einstellung des hervorragenden Oberbürgermeisters Dr. Franz Adickes verstand es allmählich diese Institutionen für den Zusammenschluss in einer grösseren Einheit zu erwärmen, ihre Ziele als Bildungsstätten noch mehr zu vertiefen, sie zur Universität zu entwickeln. Adickes ist als der eigentliche Schöpfer der Frankfurter Universität zu bezeichnen. Es gelang ihm nicht nur eine Reihe weiterer, grosser Stiftungen zu veranlassen, er verstand es auch, die Stadt Frankfurt tätiger in die neue Aufgabe einzustellen und auf ihn vor allem geht es zurück, wenn die Frankfurter Universitätsgründung einen für Deutschland durchaus neuen Typus der Universitätserrichtung vorstellt. Sie ist die erste deutsche Universität, welche aus der freien Kooperation selbständiger Körperschaften für Forschung und Lehre entsprungen ist. Sie besitzt fünf Fakultäten, nämlich eine juristische, medizinische, philosophische, naturwissenschaftliche, und eine Fakultät für Social- und Handelswissenschaften.

Es hängt mit der Entstehungsgeschichte der Universität zusammen, dass ihre zahlreichen, durchwegs modernen Gebäude nicht zu einem einheitlichen Baukomplex zusammengefasst sind. Zwei Zentren in ungefähr halbstündiger Entfernung von einander, sind auseinander zu halten. Das eine Areal liegt im Nordwesten der Stadt. Hier war im Jahre 1906 das grosse Stiftungsgebäude der Akademie für Social- und Handelswissenschaften entstanden, hier hatten die grossen naturwissenschaftlichen Gesellschaften mächtige Museen und Laboratoriumsbauten errichtet. Durch starke Anbauten ist aus dem Akademiegebäude der Hauptbau der Universität geworden, in welche nun die Akademie selber aufging. Hier und in den benachbarten naturwissenschaftlichen Instituten haben alle Fakultäten mit Ausnahme

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der medizinischen ihre Lehrstätte gefunden.

Dagegen liegen sämtliche Einrichtungen der medizinischen Fakultät jenseits des Maines im Südwesten der Stadt auf einem umfangreichen Areal in der Nähe des Stadtwaldes. Hier war seit 1884 der successive Ausbau eines grossen städtischen Krankenhauses vorgenommen worden mit zahlreichen Klinikgebäuden, Pavillons und technischen Hülfseinrichtungen. Sie wurden mit der Universitätsgründung in den Dienst des wissenschaftlichen Unterrichtes gestellt, wofür auch vorher schon Anfänge bestanden, haben aber nach wie vor ihre Hauptaufgabe als Heilstätten behalten und sind unter direkter Verwaltung der städtischen Behörden geblieben.

Ein kleinerer Teil der heute im Krankenhausareal stehenden Gebäude, die Institute für Anatomie, für animale Physiologie, Pharmakologie, Neurologie und Zahnheilkunde, sowie das nicht sehr weit entfernte Orthopädische Institut, sind nicht in städtischem Besitz und nicht unter städtischer Verwaltung, sondern gehören selbständigen Stiftungen, die hier in neuerer Zeit erst moderne Neubauten errichtet haben, oder in städtischen Bauten ein selbständiges Leben führen. Auch ein staatliches Institut, nämlich das durch Paul Ehrlichs Namen weltbekannte Institut für experimentelle Therapie ist den Krankenhausbauten aufs nächste benachbart.

Das neue anatomische Institut, welches dem Unterricht für systematische und topographische Anatomie, sowie für Histologie und Entwickelungsgeschichte dient, gehört der Dr. Senckenbergischen Stiftung und ist nach dieser benannt. Diese Stiftung besteht seit dem Jahre 1763, fusst auf einer der grosszügigsten Schenkungen jener Zeit und ist schon von Goethe mit Bewunderung genannt worden. Der Frankfurter Arzt Johann Christian Senckenberg hatte in dem genannten Jahr seiner Vaterstadt ein grosses Kapital für die Errichtung eines Bürgerhospitales, einer Anatomie, eines botanischen Gartens und eines chemischen Laboratoriums übergeben. Die drei ersten Aufgaben kamen aus der Schenkung zur Durchführung. Das Bürgerhospital, vor dem Kriege in beträchtlichem Umfang erneuert, ist selbständig geblieben, die Anatomie und das botanische Institut mit Garten sind der Universität eingefügt worden. Bis 1885 war das anatomische Institut der beschreibenden Anatomie dienstbar und sah seine Hauptaufgabe darin, den Frankfurter Ärzten die Mehrung und Vertiefung ihrer anatomischen Kenntnisse zu bringen, welche noch immer die Ausübung der Heilkunst geför-

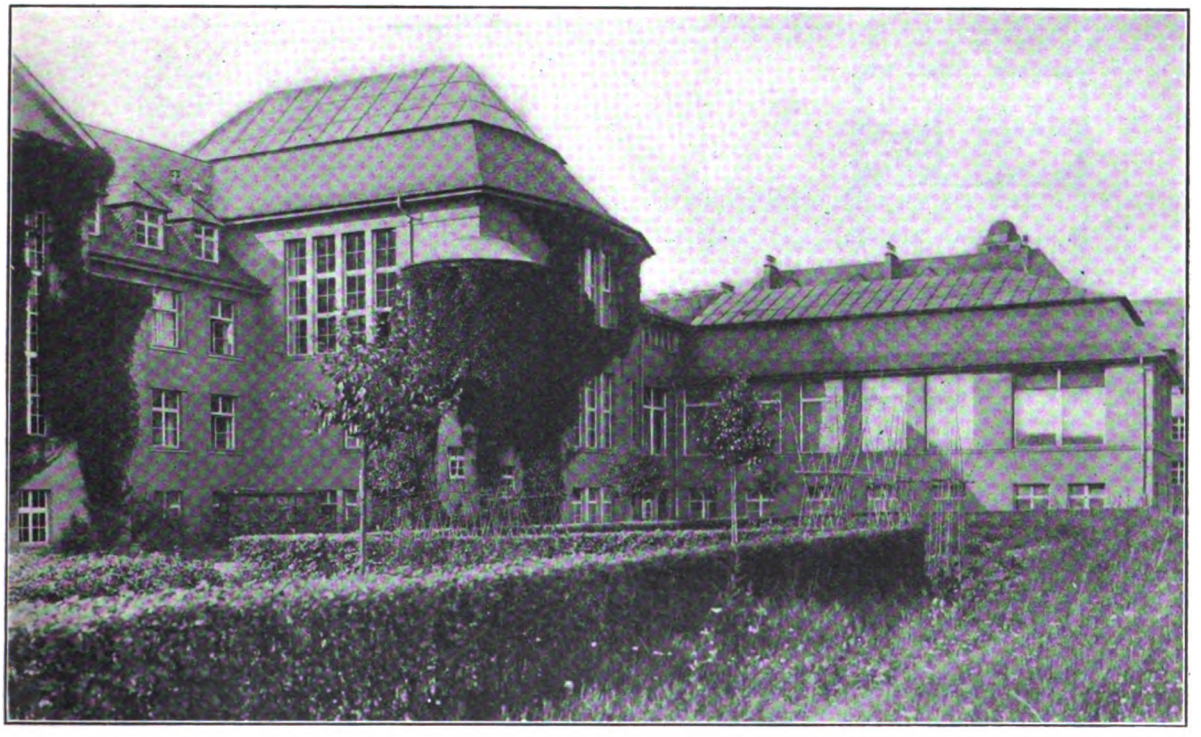

FIG. 3.—SÜDFRONT MIT DEM WISSENSCHAFTLICHEN FLÜGEL (GANZ LINKS), DEM ZENTRALBAU (MIT HÖRSAAL UND WENDELTREPPE), SOWIE DEM PRÄPARIERSAALFLÜGEL (RECHTS)

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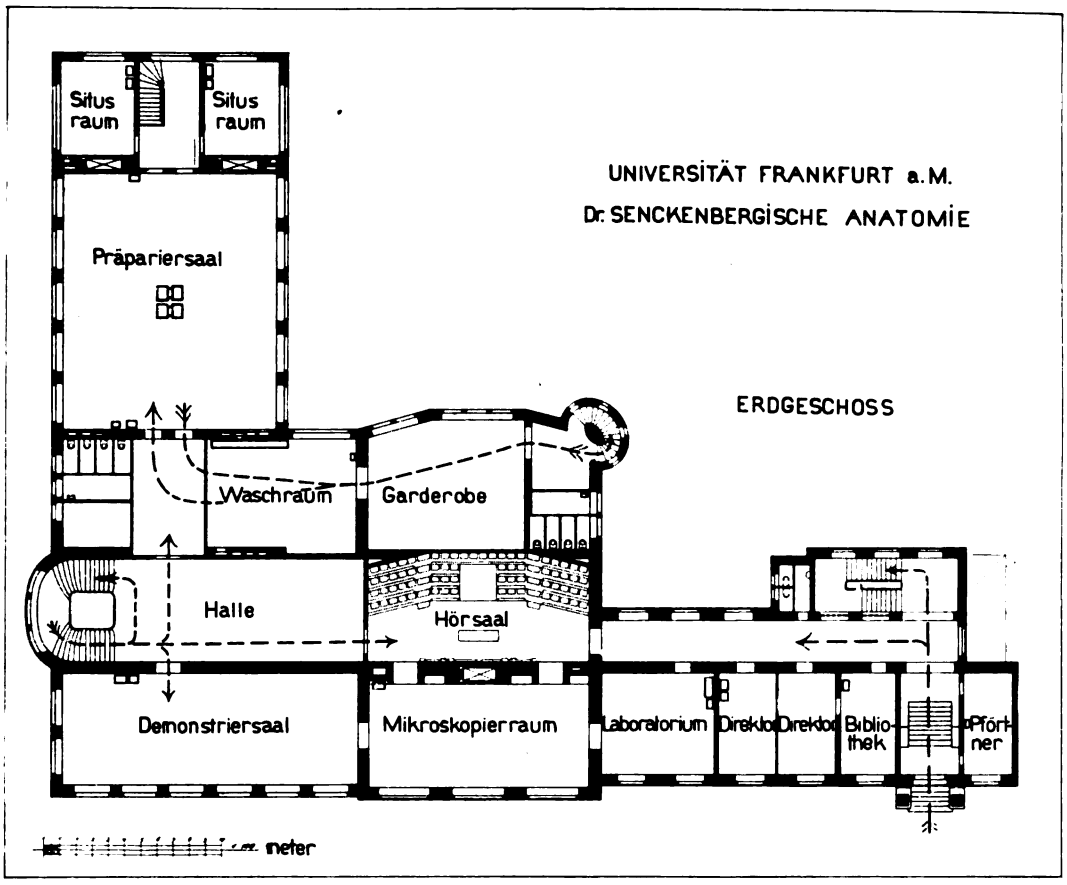

FIG. 4

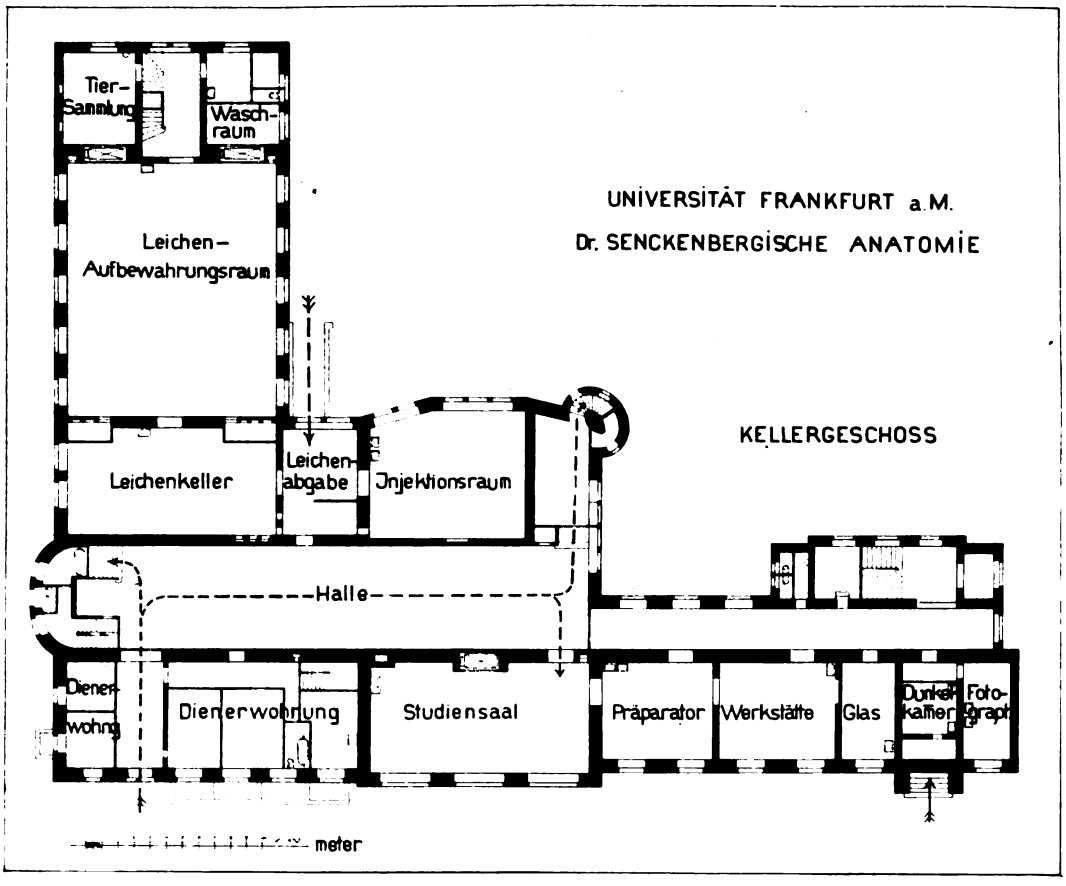

FIG. 5

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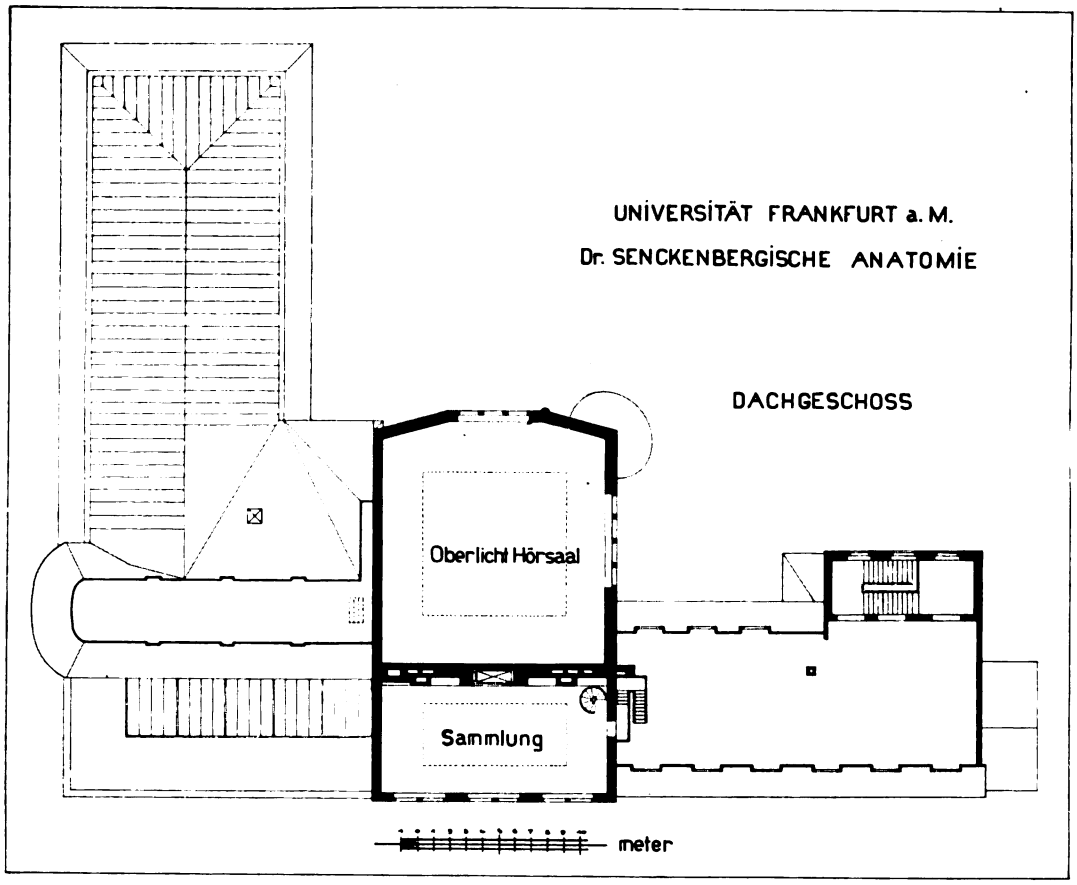

FIG. 6

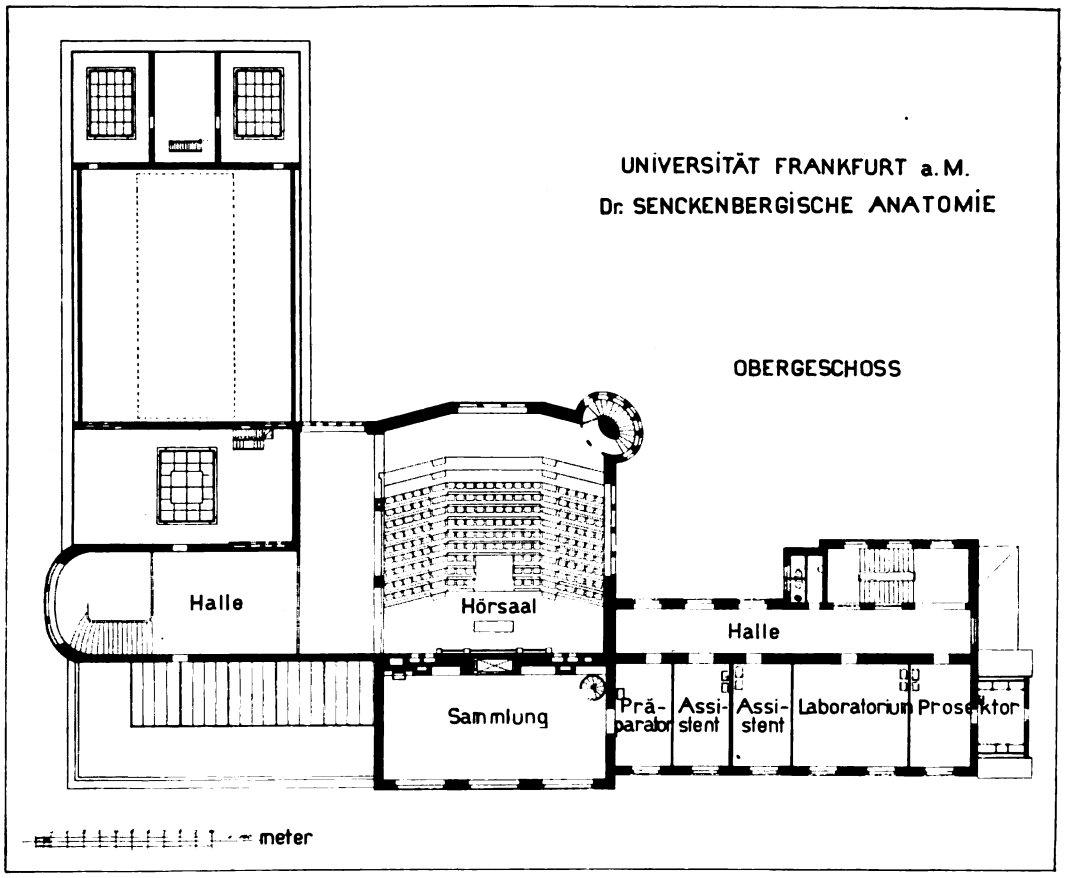

FIG. 7

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dert haben. Auch manche wissenschaftliche Entdeckung ist hier gemacht worden. In den achtziger Jahren des vergangenen Jahrhunderts trat das „theatrum anatomicum" in den Hintergrund. Unter Karl Weigerts geistreicher Leitung wurde aus der Senckenbergischen Anatomie ein pathologisches Forschungsinstitut mit Weltruf. Erst mit der Anbahnung der Universitätsgründung fiel der Senckenbergischen Stiftung wieder die alte Aufgabe zu, der normalen Anatomie eine Lehr- und Forschungsstätte zu schaffen, was sie in dem zu beschreibenden Neubau in sehr grosszügiger Weise getan hat. Der Universitätsvertrag sah auch vor, dass die ganze Verwaltung des Institutes durch die Stiftung zu leiten wäre und dass hauptsächlich aus Stiftungsmitteln der Betrieb erfolgen solle. Es ist anders gekommen. Die Inflationsperiode hat alle flüssigen Mittel der Stiftungen aufgezehrt. So fällt heute Verwaltung und Betriebssicherung der Universität zu, welche selber durch erhebliche Zahlungen der Stadt Frankfurt, des Landes Preussen und zeitweilig auch Reichszuschüsse erhalten wird.

DAS GEBÄUDE UND SEINE EINRICHTUNG

Die Dr. Senckenbergische Anatomie ist in den Jahren 1913-1914 unmittelbar am Mainfluss mit einem Kostenaufwand von rund 350 000 Goldmark für das Haus und 40 000 Mark für die Inneneinrichtung nach Plänen von Magistratsbaurat Wilde erbaut worden. Als anatomischer Berater wirkte zunächst Geheimrat Emil Gasser in Marburg, dann der neu ernannte erste Direktor des Institutes Prof. Ernst Goeppert, welcher namentlich auf die innere Einrichtung wichtigen Einfluss ausgeübt hat.

Die langgestreckte Hauptfront (Fig. 2) ist dem Main parallel und einfach gehalten; stärker gegliedert, mit einem nach Süden weit vorspringenden Präpariersaalflügel versehen, ist die Südseite (Fig. 3). Derselbe Grundgedanke, welcher Geheimrat Gasser beim Neubau der Marburger Anatomie gelenkt hatte, die möglichst klare bauliche Trennung zwischen jenem Gebäudeteil, der für die gewöhnlichen Unterrichtszwecke dient und einem anderen, der für die Forschung bestimmt sein soll, ist auch in Frankfurt massgeblich geworden. Die Lösung wurde hier so erreicht, dass die 60 m lange Hauptfront in drei Strecken gegliedert wurde, die aber alle ziemlich in derselben Flucht liegen und sich nur durch ihre Höhe und innere Gliederung unterscheiden. Der mittelste Teil wurde als Zentralteil am meisten betont. In ihn wurden der grosse Hörsaal und die Sammlungsräume gelegt. An ihn schliesst sich nach Westen der ursprünglich umfänglicher geplante, wissenschaftliche Flügel an, indessen sich nach Osten der niedrigere Unterrichtsteil anreiht, welcher in einem langen, südwärts gerichteten, einstöckigen Präpariersaalflügel ausläuft. Der Zugang für die Leichenzufuhr liegt südlich; an der nordwärts gerichteten Hauptfront finden sich je ein besonderer Eingang zum Unterrichtsbau und zum wissenschaftlichen Flügel. Der Zentralteil ist nur von den Seiten her zugänglich.

Das gesamte Gebäude ist als Backsteinbau mit Decken und Treppen aus Eisenbeton errichtet, ist mit Besenwurf verputzt und hat eine Grundfläche von 1446 qm. Es besitzt überall ein ausgebautes Kellergeschoss, das neben den Wohnungen für die Diener, sämtliche Räume zu technischen Zwecken und zur Leichenkonservierung enthält. Seine Stockwerkhöhe beträgt 3,4 m. Auch das hochgelegene Erdgeschoss geht gleichmässig durch alle Bauteile durch und hat im allgemeinen 4 m Stockhöhe, aber diese wird in verschiedenen, grossen Räumen beträchtlich überschritten. Im Zentralteil ist das nördliche Drittel mit ausgebautem Ober- und Dachgeschoss versehen und liegt das Oberlicht des letzteren in gleicher Höhe wie jenes des grossen Hörsaales, der also durch drei Stockwerke durchgeht und eine innere Höhe von 10,5 m erreicht. Im Ostteil des Gebäudes hat nur die mittlere Partie, welche das Haupttreppenhaus enthält, ein hohes Obergeschoss, dagegen ist im Präpariersaalflügel das Oberlicht in 7,2 m Abstand vom Erdgeschossboden angebracht und auch der, in der Nord-Ostecke gelegene, grosse Demonstrationssaal weist, wieder mit Oberlicht versehen, eine innere Höhe von 4,8 m auf. Während im allgemeinen eine ziemlich steile Bedachung mit Schieferbelag durchgeführt ist, haben der Zentralbau und der Präpariersaalflügel in der Mitte grosse, gefirstete Eisenkonstruktionen mit umfangreichen Drahtglaseinlagen, welche reichlich Licht auf die inneren Oberlichter niederfluten lassen. Auch über dem Demonstrierraum besteht eine Drahtglasdachkonstruktion. Die Stockwerkhöhen im wissenschaftlichen Teil und Zentralbau, soweit hier nicht der grosse Hörsaal in Betracht steht, betragen je 4 m für Erd- und Obergeschoss und 3,1 für das Dachgeschoss. Es ergibt sich ein gesamter umbauter Raum von 21 260 cbm und damit (incl. Inneneinrichtung) eine Gesamtausgabe von 18,45 Mark für den Kubikmeter, ein Preis, der natürlich nur in der Vorkriegszeit möglich war.

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Es sind zwei Haupttreppenhäuser vorhanden. Jenes im Unterrichtsteil ist breit, hoch und kunstvoll gestaltet, jenes im wissenschaftlichen Flügel ist schmäler und einfacher gehalten. Daneben besteht noch ein drittes, schmales, als Wendeltreppe gewickeltes Treppenhaus, welches an die Süd-Westecke des Hörsaales angelehnt ist und auch auf Fig. 3 von aussen erkennbar wird.

Die Anordnung der Treppenhäuser hängt innig zusammen mit der zweifachen Art des Unterrichtes, der einerseits in Vorlesungen, andererseits in den praktischen Übungen besteht. Der grosse Hörsaal muss für die vielen Studenten

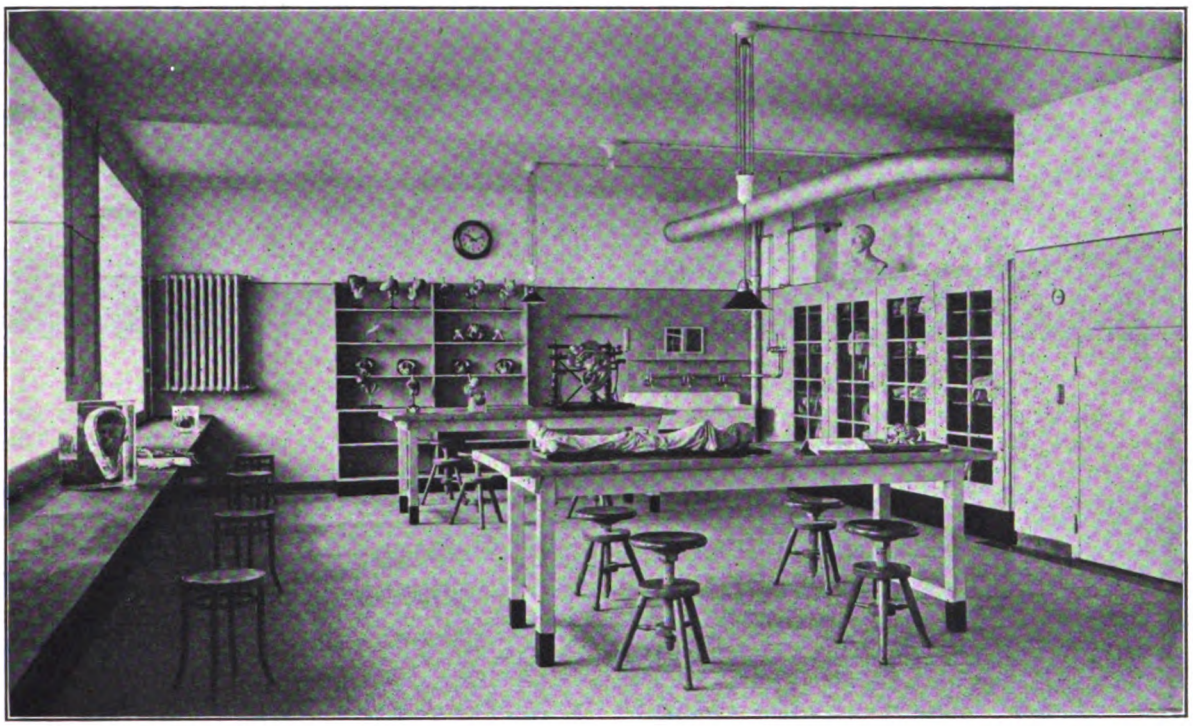

FIG. 8.—STUDIENSAAL

rasch von allen Seiten zugänglich sein und sich ebenso rasch wieder entleeren können. Zu den Übungen kommen die Leute weniger gleichzeitig, haben ihre Garderobe zu wechseln und müssen sich nach denselben waschen können. Diesen Bedürfnissen ist in der Anlage zweckmässig Rechnung getragen. Ich habe den Weg, den die Studierenden nehmen in den Figuren 4 und 5 durch gestrichelte Linien gekennzeichnet. Sie kommen durch den östlichen Eingang der Nordfront in das Kellergeschoss, das hier eine lange und breite Halle zeigt, welche sich zum Abstellen der Fahrräder eignet. Wollen sie eine Vorlesung hören, dann steigen sie durch das östliche Treppenhaus empor und finden sowohl im Erd- als im Obergeschoss eine grosse Halle zur Ablegung ihrer Garderobe und einen bequemen Zugang zum Hörsaal, bezw. zu dessen Galerie. Wollen sie aber zu den Präparierübungen gehen, dann ist ein anderer Weg für sie besser geeignet. Sie steigen durch die Wendeltreppe bis ins Erdgeschoss empor (man kann auch über sie bis zum obersten Teil des Hörsaales aufsteigen) gelangen nun in eine Garderobe, welche unter die Oberstufen des grossen Hörsaales eingebaut ist, legen dort ihre Mäntel und Röcke ab und kommen dann in den Waschraum, wo die Präpariermäntel hängen, ziehen diese an und begeben sich nun an ihre Präpariersaalarbeit. Nach Schluss derselben legen sie die Präparierkleidung im Waschraum wieder ab, reinigen sich gründlich und kommen jetzt erst wieder an ihre zivile Kleidung, worauf sie über die Wendeltreppe und durch die Kellerhalle das Gebäude verlassen.

In den Westflügel führt, wie gesagt, ein besonderer Eingang. Er leitet über eine teilweise äussere, teilweise innere Treppe (Fig. 4) unmittelbar ins Erdgeschoss und von hier ist sowohl der Weg nach dem Hörsaal frei, als auch die Möglichkeit gegeben durch die westliche Haupttreppe in die oberen Stockwerke zu gelangen.

Eine knappe Schilderung der einzelnen Stockwerke möge nunmehr sich anschliessen. Es wird

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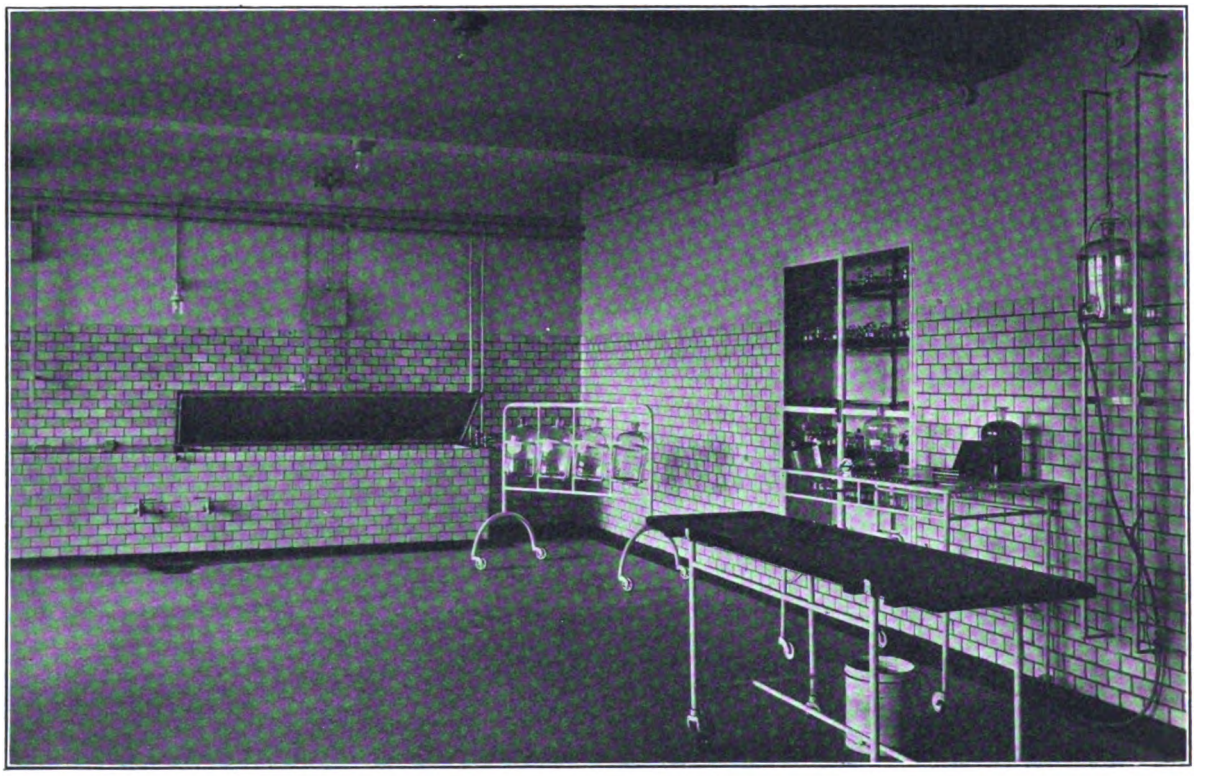

FIG. 9.—INJEKTIONSRAUM

dabei auch des inneren Betriebes und der spezielleren Einrichtung zu gedenken sein.

DAS KELLERGESCHOSS (FIG. 5)

Die über 30 m lange Halle des Kellerstockes trennt scharf eine Flucht nördlich und südwärts gelegener Räume. Zwischen den Dienerwohnungen liegt der Eingang für die Studierenden. Ihnen dient auch ein anderer nördlicher Raum, der schon im Zentralbau liegt, der Studiensaal (Fig. 8). Er ist bestimmt als Tag- und Aufenthaltsraum benutzt zu werden und bietet durch eine kleine Bibliothek von Lehrbüchern und Atlanten, sowie durch zahlreiche Modelle und Studienpräparate Gelegenheit das Lehrpensum durch private Studien zu ergänzen und zu vertiefen. Das hier befindliche Lehrmaterial steht unter geregelter Selbstverwaltung der Studierenden. An den Wänden sind zahlreiche Zeichnungen und Bilder mit anatomischem Inhalt aufgehängt. Zeitweilig ist dieser Raum auch als kleiner Präpariersaal benutzt worden. Eine neuerdings angebrachte sehr gute indirekte Deckenbeleuchtung macht ihn dafür, trotz seiner nur mässigen Höhe wohl geeignet.

Völlig getrennt von diesen Nordräumen liegen auf der anderen Seite der Halle die Leichenräume. Zu ihnen kann man nur durch eine Türe von der Halle aus gelangen und diese selbst führt wieder in einen Vorraum, in welchem Leichen nicht aufbewahrt werden. Die Verhältnisse sind so gewählt, um eine völlige Geruchlosigkeit im Hauptgebäude zu erreichen. Eine Zufahrt von Süden her führt ebenfalls zu jenem Vorraum, der sogenannten Leichenabgabe, aus welcher die Leiche alsbald in den Injektionsraum (Fig. 9) gebracht wird. Er ist, wie alle Leichenräume, mit Terrazzoböden und Plättchenbelag an den Wänden ausgestattet und daher sehr leicht zu reinigen.

Zur Leicheninjektion verwenden wir in der Regel ein Gemisch von 1000 ccm Formaldehyd (40 prozentig), 3000 ccm Alkohol (95 prozentig) und 8 Liter Wasser. Ausserdem sind 100 gr. Salicylsäure beigefügt, die warm in Alkohol gelöst werden. Die eingespritzte Leiche kommt sodann in den Leichenkeller, der jenseits der Leichenabgabe sich findet, und wird dort für vierzehn Tage in einem grossen Becken in 4 prozent. Formalinlösung nachfixiert. Hier finden sich auch die Einrichtungen, um Leichen mit heissen Massen einspritzen zu können und Wasserbecken zu Mazerationszwecken. Der Leichenaufbewahrung dient ein ganz grosser

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Kellerraum unter dem Präpariersaal (Fig. 10). Er besitzt in zwei Reihen zwanzig lange Zementtröge, von denen jeder drei ganze Körper aufnehmen kann. Die Konservierungsflüssigkeit ist schwache Formalinlösung oder mit Wasser stark verdünnter Alkohol. Carbolsäure suchen wir möglichst zu vermeiden. Der Geruch in den meisten Anatomieen, der schliesslich das ganze Haus durchdringt, ist ganz vorwiegend auf die Carbolsäureverwendung zurückzuführen. Die Frankfurter Anatomie kann als geruchlos gelten, was jeder Besucher angenehm feststellt. Neben den grossen Leichenaufbewahrungsbecken besitzen sowohl der Hauptraum, als auch der Leichenkeller und Injektionsraum noch eine ganze Reihe kleinerer Tröge, geeignet für Körperhälften, Extremitäten und Eingeweidepräparate. Zwei Aufzüge, die elektrisch betrieben werden, führen am hinteren Ende des Leichenaufbewahrungsraumes sowohl nach dem Präpariersaal, als nach den Nebenräumen desselben für Situserklärungen. Sie sind in die Wand eingebaut, welche den Aufbewahrungsraum von Baderäumen für die Leichendiener trennt. Auch findet sich dort noch ein Raum, der als Gefrierraum ausgebaut werden soll und vorläufig als Sammlung für konservierte Tierkadaver dient.

In den wissenschaftlichen Flügel setzt sich die grosse Kellerhalle durch einen längeren Korridor fort. An ihn stossen nördlich an: der Raum für den Präparator, die mit Säge- Bohr- Dreh- und Schleifmaschinen ausgestattete Werkstatt, sodann ein Glasraum, die Dunkelkammer und das Zimmer für Mikrophotographie. Jenseits des Korridors liegen kleinere Nebenräume für Reinigungszwecke und steigt die Westtreppe empor.

Das Erdgeschoss (Fig. 4)

Der Studierende, welcher durch das Haupttreppenhaus im Osten zum Erdgeschoss aufsteigt hat hier aus der fast 20 m langen Garderobehalle unmittelbaren Zugang zu allen Haupträumen des Unterrichtes. Geradeaus kommt er in den Hörsaal, nach rechts in den ausserordentlich hellen Demonstriersaal, nach links kann er zum Waschraum und dem Präpariersaal und steigt er weiter über die Treppe empor, dann gelangt er zur Hörsaalgalerie.

Der Demonstriersaal (Fig. 11) hat 18 m Länge und fast 7 m Breite. In ihm werden die zu den Vorlesungen gehörigen Demonstrationen abgehalten. An seiner Südwand ist in grossen Glasschränken die Sammlung anatomischer und entwickelungsgeschichtlicher Modelle aufgestellt, welche den Studierenden zur Besichtigung ebenso jederzeit zugänglich bleibt, wie die jede Woche wechselnde ständige Demonstration von in Gläsern aufge-

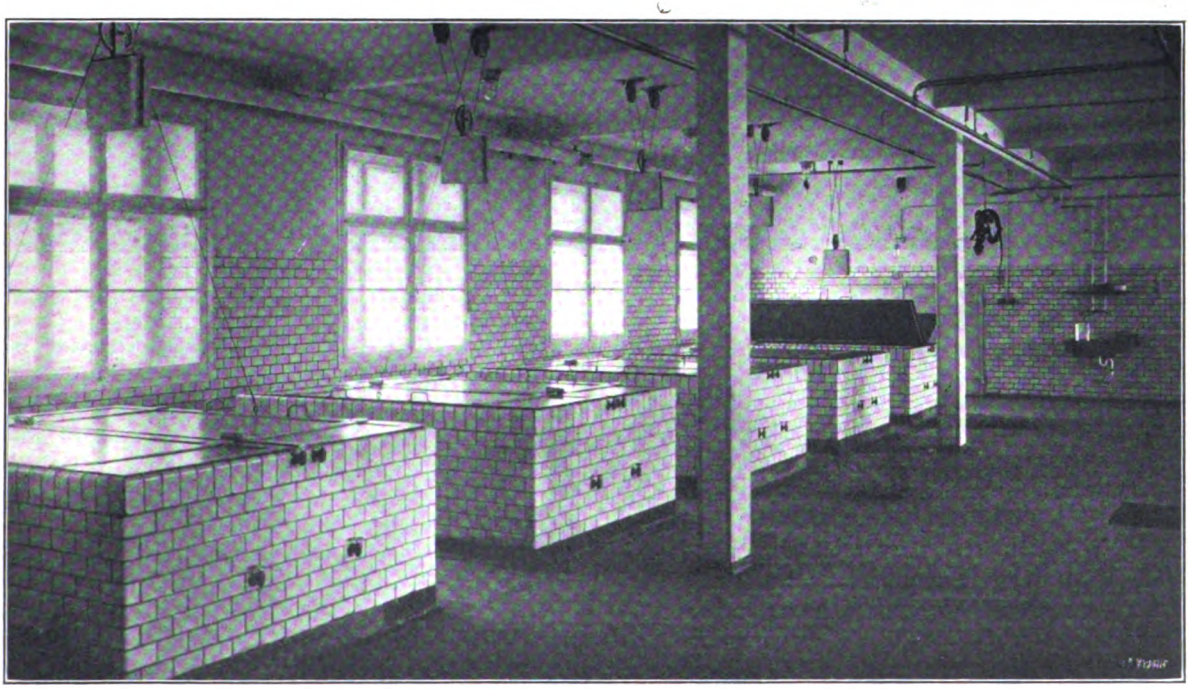

Fig. 10.—Aufbewahrungsraum für Leichen mit der einen Reihe von Zementbecken zur Konservierung ganzer Körper

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stellten und mit Erklärungsblättern versehenen Sammlungspräparaten.

Der Präpariersaal (Fig. 12) ist mit 200 qm Bodenfläche und über 7 m Höhe ein sehr stattlicher Raum von denkbar grösster Helligkeit. In ihm können etwa 200 Studierende gleichzeitig an der Leiche arbeiten. Über seine ganze Länge dehnt sich ein 6 m breites Oberlicht aus, an seinen beiden Längsseiten liegen zusammen zehn hohe Spiegelglasfenster, zwischen denen nur zig Kursteilnehmer schaffen. Aber der Raum ist im Sommer durch seine Glasüberdachung sehr warm und lässt sich auch durch eine umfangreiche Ventilationseinrichtung, die zwischen Oberlicht und Glasdach heisse Luft absaugt und von der Nordseite Bodenluft zuleitet, nicht genügend abkühlen. Für Neubauten mit ähnlichem Zwecke dürfte es sich empfehlen, lieber mit noch höher geführten Seitenfenstern, als mit so umfänglichem Oberlicht zu rechnen.

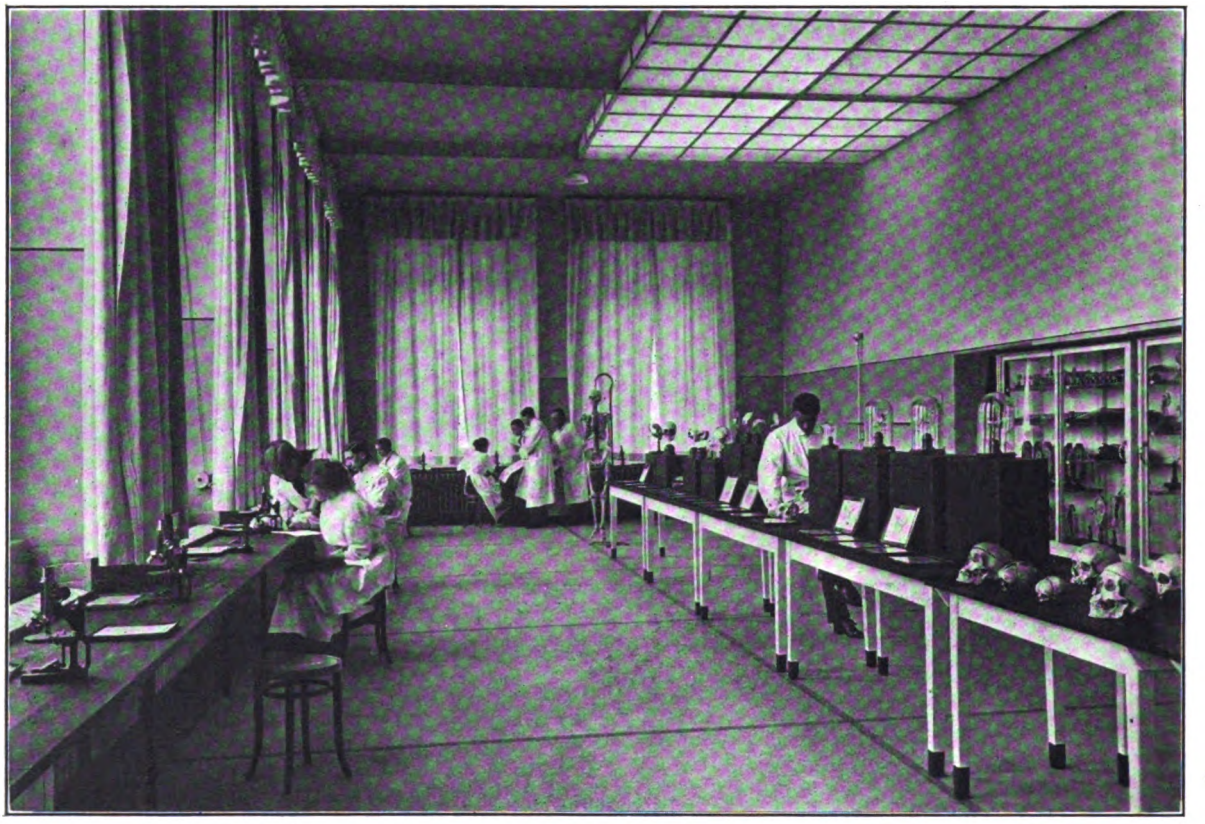

FIG. 11.—DEMONSTRIERSAAL

schmale Wandpfeiler stehen. Bei Dunkelheit dienen grosse elektrische Birnen hoch, nahe unter dem Oberlicht angebracht, zu völlig genügender Erhellung. Ursprünglich lag die künstliche Beleuchtung zwischen Oberlicht und Glasdach und bestand aus acht elektrischen Lampen zu je 1000 Kerzen. Das gab ein ganz vorzügliches, diffuses Licht, aber die Stromkosten waren sehr erheblich. Die Verlegung der Beleuchtungseinrichtung unter das Oberlicht ermöglichte beträchtliche Ersparnisse und noch wohl genügende Leistungen. Im Sommer hat, wenn die Kurse stark besucht sind, der Präpariersaal als Mikroskopiersaal zu dienen. Es werden dann sechs lange Tischreihen aufgebaut, die Plätze für etwa acht-

Das ganze Mobiliar des Präpariersaales ist leicht transportabel. Eingebaut sind nur vier Emailtröge in der Mitte zum Waschen von Präparaten und seitlich eine kleine Anzahl von Waschbecken zum Reinigen der Hände. Mit voller Absicht ist der eigentliche Waschraum vom Präpariersaal getrennt worden.

Kurz möchte ich auch der bei den Präparierübungen gebrauchten Tische gedenken. Wir haben derer drei Arten. Für ganze Leichen dienen grosse Bretter mit Randleisten von 2 m Länge und 55 cm Breite. Sie werden auf leicht transportabel Holzböcke aufgelegt. Für halbe Körper und Extremitäten benutzen wir Tische von 1 m auf 50 cm Fläche, für Gehirn- und

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Eingeweidepräparation meistens kleinere Tischchen mit quadratischer Platte von 42 cm Rand. Die beiden letzteren Arten haben unter der Tischplatte noch ein Ablegebrett für Bücher und Instrumente. Bei Präparation an der ganzen Leiche sind besondere Ablegeständer im Gebrauch, wie solche auf Fig. 12 leicht erkennbar sind. Als Sitzgelegenheiten dienen Drehstühle ohne Lehnen.

Am südlichen Ende des Präpariersaales leiten zwei Türen nach einem Vorraum, von wo einerseits das Personal leicht in den Leichenkeller gelangen kann, andererseits die Studierenden nach rechts, wie nach links Zugang zu je einem kleineren, wieder ausserordentlich hellen Situsraum (Fig. 13) haben. Diese viel gebrauchten Räume werden für Demonstrationen der Eingeweidelagerung und für Unterricht in Gruppen benutzt. Sie haben sowohl Wascheinrichtungen, wie vorzügliche künstliche Beleuchtung, der eine von ihnen auch einen drehbar eingebauten Leichentisch.

Zwischen Erdgeschosshalle und Präpariersaal finden sich Klosets auf der einen Seite des Zuganges, der Waschraum auf der anderen Seite. Unsere Abbildung lässt den 5 m langen Waschtrog allerdings nicht erkennen, er liegt seitlich vom Standpunkt des Photographen, dagegen sind die Ständer mit den Präparierkleidern der Studierenden zu sehen. Drei Seiten dieses Raumes sind ferner mit verschliessbaren Schrankfächern versehen, welche an die Studenten vermietet werden. Solche finden sich weiter in der Garderobe für die Strassenkleidung. Ist auch der Garderoberaum passiert, dann folgen nochmals Klosets und steht der Abstieg durch die Wendeltreppe frei.

Von dem ungewöhnlich grossen Hörsaal vermag die Fig. 14 nur einen unvollständigen Eindruck zu vermitteln. Es gibt keinen Punkt von dem aus sich der Saal, welcher stufenartig ansteigt, als Ganzes photographisch wiedergeben lässt. Doch hat jeder Studierende den Blick auf Podium und Tafeln frei. Bisher sind gegen 200 Sitzplätze eingebaut, ihre Zahl kann noch vermehrt werden, im Maximum werden gut 300 Hörer Platz finden können. Ein quadratisches Oberlicht mit je 9 m Seite, grosse hochliegende Fenster an der Süd- und Westwand, machen den Raum sehr hell. Durch Zugvorhänge wird direkte Besonnung ausgeschaltet. Eine elektrische Einrichtung ermöglicht in kürzester Frist die Verdunkelung des ganzen Saales, der gegenüber dem einfachen Podium einen Zeiss'schen Projektionsapparat enthält, der sowohl Mikro- als Makroprojektion im durchfallenden und auffallenden Licht erlaubt. Die künstliche Beleuchtung ist neuerdings, wie im Präpariersaal unter das Oberlicht gelegt worden, sie wird durch drei Lampen zu 400 Kerzen ausreichend geleistet.

Die Nordwand des grossen Hörsaales enthält wieder einen elektrischen Aufzug, der vom Keller- bis zum Dachgeschoss durchläuft. Er ermöglicht aufs leichteste aus den Sammlungen im Oberstock und Dachgeschoss Präparate ins Erdgeschoss oder den Studiensaal zu bringen. Im Erdgeschoss öffnet er sich in den Mikroskopiersaal, welcher nordwärts vom grossen Hörsaal die ganze Breite des Zentralbaues einnimmt. In ihm werden mikroskopische Kurse mit bis zu vierzig Teilnehmern abgehalten. Auch dient er als kleiner Hörsaal und enthält die Aufbewahrungsschränke für die Vorlesungstafeln.

Endlich finden sich im Erdgeschoss des wissenschaftlichen Bauflügels, an den Mikroskopierraum sich anreihend, ein Laboratorium, in welchem makroskopische Arbeiten ausgeführt werden, dann das Privatlaboratorium und der Empfangsraum des Direktors, ein leider nicht genügend grosser Bibliotheksraum und jenseits der Treppe des Westeinganges ein Pförtnerzimmer, welches auch die Telephoneinrichtungen für Stadt- und Ferngespräche enthält. Jenseits des Flures steigt am westlichen Ende die Treppe zum Oberstock auf. Hier und in dem Erdgeschossflur sind Ölgemälde der Anatomen, welche am Senckenbergischen „theatrum anatomicum" lehrten, aufgehängt.

Das Obergeschoss (Fig. 7) und Dachgeschoss (Fig. 6)

Im Ostbau ist das Obergeschoss nur durch die oberste Halle, welche zur Hörsaalgalerie führt, und einen Nebenraum, der über dem Waschraum und den Klosets des östlichen Erdgeschosses liegt, vertreten. Der letztere eignet sich ganz vorzüglich zu Aquarien- und Terrarienzuchten.

Im Mittelbau liegt über dem Mikroskopierraum die anatomische Sammlung (Fig. 15), welche einen Zugang nur vom Westflügel her besitzt, aber durch die Aufzugsvorrichtung leicht für Unterrichtszwecke nutzbar zu machen ist. Ein zweiter, ebensogrosser Sammlungsraum, etwas niedriger, dafür aber mit Seiten- und Oberlicht versehen, liegt im Dachgeschoss. Eine einstöckige eiserne Wendeltreppe verbindet ihn mit dem unteren Sammlungsraum. Vorläufig reicht die untere Sammlung noch aus die Objekte kunstvoller präparatorischer Tätigkeit aufzu-

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nehmen, die einen so wertvollen Beitrag für jeden tiefer strebenden anatomischen Unterricht abgeben. Als die neue Frankfurter Anatomie eröffnet wurde fehlte es ganz an einer anatomischen Sammlung. In der Periode, da das alte „theatrum anatomicum" zum pathologischen Institut gewandelt war, muss viel ältere anatomische Arbeit nicht genügend gewürdigt worden sein und kam in Verlust. So besitzt die Anatomie aus jener älteren Periode nur noch eine kleine Schädelkollektion, einige Skelette und getroknete Gefässpräparate, sowie ein Vermächtnis des Züricher Anatomen Herrmann von Meyer mit den Originaldokumenten seiner so wertvollen Untersuchungen über die funktionelle Struktur der menschlichen Knochen und Gelenke.

Die ganze Unterrichtssammlung musste neu geschaffen werden und zwar unter den Bedingungen der schweren Kriegszeit und der nicht günstigeren Nachkriegsperiode. Was das besagt, vermag der Aussenstehende nicht zu ermessen. Es genügt aber beizufügen, dass bis heute das Institut keinen ausgebildeten makroskopischen Präparator zur Verfügung hatte und dass aus zielbewusster Tätigkeit der Lehrkräfte und besonders tüchtiger Studierender dennoch eine, wenn auch noch verhältnismässig kleine, dafür aber in den Leistungen höchst beachtenswerte Sammlung entstanden ist, bei deren Anlegung fast immer nicht nur präparatorische Geschicklichkeit, sondern auch ästhetische Gesichtspunkte und pädagogische Zielstellung mit ausschlaggebend waren. Der Schreibende hat sich selbst dieser Aufgabe mit grossem Eifer gewidmet und sich dafür eingesetzt, dass dauernd mustergültige Sammlungspräparate den Studierenden reichlich gezeigt werden, bei denen ganz besonders immer auch die topographischen Beziehungen sorgfältig erhalten geblieben sind. Ein Regal dieser Sammlung mit einer Anzahl solcher Präparate die zumeist in Formalinlösung aufbewahrt werden, gebe ich in Figur 16 wieder.

Im wissenschaftlichen Bauteil schliesst sich an die Sammlung das Zimmer der mikroskopischen Laborantin an, darauf zwei Assistentenzimmer, von denen eines in Fig. 17 die Inneneinrichtung zu erkennen gestattet, dann folgt das Laboratorium für mikroskopisch und embryologisch arbeitende Praktikanten, sowie schliesslich zwei Zimmer für den Prosektor des Institutes. Das Laboratorium und Laborantinnenzimmer sind mit Abzugsvorrichtungen versehen, wie sie in chemischen Laboratorien üblich sind. Sämtliche Räume der Lehrkräfte haben elektrische Thermosthaten. Das Dachgeschoss des Westflügels ist vorläufig noch nicht ausgebaut, kann aber ohne grosse Kosten fertig gestellt werden sobald dringender Raumbedarf entsteht. Es wird daran gedacht hier mit der Zeit vielleicht ein anthropologisches Laboratorium mit Sammlung zu errichten, welche Disziplin an der Frankfurter Universität bisher nicht die Beachtung gefunden hat, die ihr gebührt.

Es ist noch notwendig zu betonen, dass alle Räume des Baues mit elektrischer Beleuchtung, mit Kalt- und Warmwasserleitung, sowie mit Haustelephon versehen sind. Die Heizanlage ist eine Niederdruck-Dampfheizung mit Fernleitung. Ihre Bedienung, wie auch die Warmwasserversorgung erfolgt durch das städtische Krankenhaus, der Institutsbetrieb hat damit nichts zu tun. Die Wände der zahlreichen Räume haben meistens bis zu 2 m Höhe Ölfarbenanstrich, im wissenschaftlichen Flügel und im grossen Hörsaal haben die Fussböden einen Linoleumbelag, ebenso die Sammlungsräume. Alle anderen Zimmer, technischen Räume, Säle, Fluren und Hallen weisen Terrazzoböden auf. So ist die Reinigung des Institutes verhältnismässig einfach durchzuführen und kann von einer Putzfrau geleistet werden. Die Reinigung der technischen Räume und des Präpariersaales fällt allerdings den Dienern zu.

DIE METHODIK DES UNTERRICHTES UND DIE FORSCHUNGSTÄTIGKEIT

Dem Institut fällt im Rahmen der Universität der gesamte Unterricht in systematischer und topographischer Anatomie, Histologie, mikroskopischer Anatomie und Entwickelungsgeschichte zu. Als Lernende kommen naturgemäss hauptsächlich Studierende der Medizin und Zahnheilkunde in Betracht. Nach deren Bedürfnissen sind die Lehrpläne gestaltet, wobei für Mediziner vier, für Zahnärzte drei Semester sich mit anatomischen Stoffen beschäftigen. Für klinische Studierende wird ferner nochmals ein Semester lang eine Vorlesung über topographische Anatomie abgehalten. In jenen vier bezw. drei vorklinischen Semestern werden aber durchwegs auch andere Fächer von den Studenten gehört. Der deutsche Universitätsunterricht kennt die auschliessliche Konzentration auf ein Fachgebiet nicht. Von den Medizinstudenten wird in der Regel nach fünf, neuerdings nach vier Semestern die Ablegung der ärztlichen Vorprüfung erwartet, wonach der Zutritt zu den klinischen Studien freisteht. Studierende der Zahnheilkunde legen nach drei Semestern eine entsprechende Vorprüfung ab. Diese hat für die Medizinstudierenden den Beweis einer gründ-

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FIG. 12.—PRÄPARIERSAAL

lichen Durchbildung auf den Gebieten der gesamten Anatomie und Physiologie, sowie ausreichender Kenntnisse in Physik, Chemie, Zoologie, und Botanik zu erbringen. Bei den Zahnmedizinern sind die Ansprüche geringere, die Fächer Zoologie und Botanik fallen fort, dafür ist die Zahnersatzkunde ein weiteres Prüfungsfach. Vorbedingung zur Zulassung zur Vorprüfung ist für Mediziner der Nachweis, dass sie je ein Semester auf dem Gebiet der Chemie, Physiologie und Gewebelehre (mit mikroskopischer Anatomie) erfolgreich praktisch gearbeitet und dass sie während zwei Semestern an den Präparierübungen teilgenommen haben. Von den Studierenden der Zahnheilkunde wird Nachweis der einsemestrigen Teilnahme an einem chemischen Praktikum, einem Präparierkurs und einem mikroskopisch-anatomischen Kurs, sowie zweisemestrige Absolvierung eines Praktikums in Zahnersatzkunde gefordert.

Die Prüfung selbst ist für Mediziner in den naturwissenschaftlichen Fächern nur eine theoretische, in Anatomie und Physiologie recht eingehend, sowohl theoretisch als praktisch und bezieht selbstverständlich auch die mikroskopische Anatomie und Entwickelungsgeschichte ein. Von den Zahnmedizinern wird in Physik, Chemie und Physiologie eine theoretische, in Zahnersatzkunde eine eingehende praktische Prüfung, in Anatomie eine gute Erklärung anatomischer und histologischer Präparate aus den Gebieten, die für den Zahnarzt besonders wichtig sind, und ausreichendes theoretisches Verständnis des Stoffgebietes verlangt.

Ich habe diese Bemerkungen vorausgeschickt, weil die Prüfungsbestimmungen grossen Einfluss auf die Art des Unterrichtes haben. Doch ist die Durchführung desselben im Einzelnen in das Ermessen der medizinischen Fakultäten gestellt, welche wiederum den einzelnen Fachvertretern beträchtlichen Spielraum lassen, ihren Unterricht nach bestem Ermessen auszugestalten. Nur in einer Hinsicht sucht man Schranken zu ziehen, man wünscht zu verhindern, dass sich irgend ein Fach im regulären Unterricht ungewöhnlich ausdehne. Es ist daher meist ein Maximum von Wochenstunden festgestellt, aber wie die Stoffeinteilung getroffen wird, das wünscht man nicht zu uniformieren.

Jede deutsche Anatomie hat daher innerhalb gewisser Grenzen ihre besondere Unterrichtsmethode, wenn sie auch natürlich alle dasselbe

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Lehrziel besitzen. Die Intensität der Unterrichtsleistung drückt sich aber in Lehrplänen immer nur ungenügend aus. Die Lehrfreudigkeit des Dozenten entscheidet mehr as die Stundenzahl über den Unterrichtserfolg. An der Frankfurter Anatomie hat seit ihrer Eröffnung das Bestreben im Vordergrund gestanden, den Unterricht in ganz zielbewusst pädagogischer Weise zu gestalten, ihn trotz der zeitweilig sehr grossen Zahl von Studierenden intensiv und nicht extensiv durchzuführen. Sie weicht daher in ihrer Methodik von manchen anderen deutschen Universitäten ab. Der Unterschied liegt einmal in einer starken Betonung des Lehrens in kleineren Gruppen, namentlich was die Praktika anbetrifft, und ferner darin, dass der Anfängerunterricht nicht mit der Osteologie beginnt, sondern mit einem Gesamtüberblick über die physische Organisation unseres Körpers, seines Materiales, seiner Organe, der Organbeziehungen, seiner Rolle als Gesamtorganismus und seiner Stellung zu anderen Organismen. Diese reichlich mit Anschauungsmaterial versehene Vorlesung für die ersten Semester, welche als „elementare Anatomie" bezeichnet wird, soll den Körper als Ganzes, als Lebensträger kennen lehren, soll dem Anfänger die Augen öffnen für die mancherlei Gesichtspunkte der Betrachtungsweise, soll an Beispielen die Rolle der Teile aufdecken und in stellenweise ausgesprochen physiologischer Darstellung jene, den Anfänger so leicht verwirrende, scharfe Trennung zwischen einem anatomischen und physiologischen Lehrgebiet, nach Möglichkeit mildern. Wir stellen also eine synthetische Betrachtungsweise gerade im Anfang in den Vordergrund, um jene durch äussere Gründe zu Stande gekommene fachliche Trennung der Lehrstoffe mit Bewusstsein als das erscheinen zu lassen, was sie wirklich ist, ein heute notwendig gewordener Umweg zur Erfassung der lebendigen Einheit von Form und Funktion unseres Körpers. Dabei ist völlig klar, dass jene Einführung nur die grossen Gesichtspunkte zu geben vermag, diese aber sollen gerade dem Anfänger möglichst klar und deutlich zum Bewusstsein kommen, ehe er sich in die vielen Einzelheiten hineinbegibt, ohne die es keine gründliche anatomische Durchbildung geben kann.

Nachdem so ein gewisser Überblick über die physische Organisation gewonnen ist, beginnen im zweiten Semester die ausgesprochen analytischen Studien. Jetzt wird in einer grossen Vorlesung die eingehende Darstellung nach Organsystemen aufgenommen und die Behandlung des Bewegungsapparates, sowie des Darm-Respi-

FIG. 13.—SITUSRAUM ZUM UNTERRICHT IN KLEINEREN GRUPPEN

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FIG. 14.—TEIL DES GROSSEN HÖRSAALES

rations- und Uro-Genitalsystemes durchgeführt. Daneben wird der erste Präparierkurs absolviert, in welchem die Präparation der Muskeln, Bänder und Gelenke die hauptsächliche Aufgabe ausmacht, zum Teil aber auch noch Eingeweidepräparate angefertigt werden. Im dritten Semester setzt sich die systematische Hauptvorlesung fort und behandelt nun den Gefässapparat und das Nervensystem, wobei die schwierigeren Abschnitte der Gehirnanatomie noch zurückgestellt bleiben. Gleichzeitig wird eine Vorlesung über Entwickelungsgeschichte gelesen und der Kursus über Zellen-Gewebelehre und mikroskopische Anatomie durchgeführt. Im vierten Semester schliesst die systematische Hauptvorlesung mit der Darstellung des Integumentes und der Sinnesorgane, sowie einer spezielleren Hirnanatomie ab, zugleich eine Synthese des gesamten nervösen Apparates vermittelnd. Jetzt kann auch fakultativ eine Vorlesung über topographische Anatomie gehört werden, welche obligatorisch erst für Studierende in den klinischen Semestern ist. Dagegen beteiligen sich alle Studierende intensiv an dem zweiten Kursus der Präparierübungen, der neben der Gefäss- und Nervenanatomie in starkem Grade die Situsverhältnisse der grossen Körperhöhlen betont.

Ein kurzer Überblick kläre auch die für den regulären anatomischen Unterricht verwandten Wochenstunden auf:

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1. Semester (Sommer): Elementare Anatomie, 3 Stunden.

2. Semester (Winter): Systematische Anatomie, 1. Teil, 6 Stunden; Präparierübungen, 1. Kurs, 12 Stunden.

3. Semester (Sommer): Systematische Anatomie, 2. Teil, 5 Stunden; Entwickelungsgeschichte, 3 Stunden; Mikroskopischer Kurs, 6 Stunden.

4. Semester (Winter): Systematische Anatomie, 3. Teil, 2 Stunden; (Topographische Anatomie, 2 Stunden); Präparierübungen, 2. Kurs, 15 Stunden.

Es ergeben sich also insgesamt dreiundfünfzig Wochenstunden anatomischer Unterricht, während vier Halbjahren, oder durchschnittlich pro Semester dreizehn Wochenstunden für sämtliche Fächer anatomischer Lehrtätigkeit. Dass vielfach noch Spezialvorlesungen daneben einhergehen, die alle völlig fakultativen Charakter haben, ist für deutsche Verhältnisse selbstverständlich. Sie berühren die aller verschiedensten Abschnitte vergleichender Morphologie, die physische Anthropologie, experimentelle Entwickelungsgeschichte u.s.w.

Anatomische Vorlesungen ohne reichliche Vorweisung von Anschauungsmaterial bleiben immer unbefriedigend. Darum ist eine unendliche Mühe auf den Ausbau guter Demonstrationen verwandt worden. Die grössten Schwierigkeiten des jungen Institutes hingen mit dem anfänglich fast völligen Mangel einer Sammlung zusammen. Eine gekaufte Modellsammlung vermochte nur vorübergehend das Bedürfnis zu befriedigen. Der Ausbau einer gründlichen Sammlung war unerlässlich und ich habe schon oben gesagt, unter welch schwierigen Verhältnissen er in Angriff genommen werden musste. Heute sind die hauptsächlichsten Forderungen erfüllt; die Sammlung ist ganz im Hinblick auf die Demonstrationen zu den Vorlesungen durchgearbeitet worden. Ich habe grossen Wert darauf gelegt, nicht halbwertige Provisorien, sondern Objekte zu gewinnen, die unter möglichster Betonung topographischer Beziehungen den Aufbau und die Formgestalt der Organe und Organteile in absoluter Naturtreue zur Darstellung bringen. Diese Präparate sind zum grossen Teil in Gläsern so aufgestellt, dass eine beigefügte Zeichnung oder ein Erklärungsblatt dem Lernenden das Selbststudium erleichtert. Ich begnüge mich nicht mit an die Vorlesung angeschlossenen Vorweisungen der Präparate und Erklärung durch die Lehrkräfte, ich stelle den Grossteil der Objekte je für eine Woche den Studenten mit den notwendigen Erklärungen in schriftlicher Form, zu beliebigen Stunden zugänglich, zur Besichtigung auf und erlebe immer wieder die Freude, dass ein grosser Teil auch älterer Studierender, diese Gelegenheit zum Selbststudium an mustergültigen Objekten sehr eifrig benutzt. Wie bei makroskopischen Präparaten, wird mit mikroskopischen Präparaten verfahren.

Einer kurzen Beleuchtung bedarf auch noch der Präpariersaalunterricht. Die Gefahren desselben liegen einerseits in flüchtiger Ausführung der gestellten präparatorischen Aufgaben, wozu manche Studierende neigen, andererseits in einer zu weitgehenden Vertiefung in das Allerspeziellste bei gleichzeitigem Verlust des Überblickes. Die Präparierübungen sollen nicht die Kunst anatomischer Präparatoren, sondern die für den zukünftigen Arzt unerlässliche Vertrautheit mit den feineren Organisationsverhältnissen herbeiführen. Ich halte es wohl für wünschbar, aber nicht für unerlässlich, dass jeder Student jeden Körperteil selbst bis ins letzte Detail durchpräpariert. Ich halte es aber für notwendig, dass er Präparate sämtlicher Körperteile *in statu nascendi* kennen lernt und damit auch die technischen Schwierigkeiten operativen Vorgehens am Lebenden einigermassen praktisch zu ermessen vermag. Ich erreiche die verschiedenen gestellten Ziele in meinen Präparierübungen dadurch, dass ich bei der Präparation ein gemeinsames Zusammenarbeiten in kleinen Gruppen eingeführt habe, welches ursprünglich durch die abnormen Kriegsverhältnisse bedingt, allmählich zum Vorteil friedlicher Arbeit ausgestaltet worden ist. Ich will dasselbe in Kürze schildern.

Je zwei Studenten erhalten zusammen ein Präparat, je acht Studenten bilden eine Arbeitsgruppe. Sie arbeiten also an vier Objekten. Jede Woche kommt jede Arbeitsgruppe während der Präpariersaalstunden zu einer einstündigen Lehrunterredung vor einer der Lehrkräfte zum Wort. Dort werden in Frage und Antwort die Präparate durchgesprochen und das Zusammenarbeiten kontrolliert und ergänzt. Ich lasse z.B. von einer Arbeitsgruppe gleichzeitig durch vier Leute an einer Leiche die Brustmuskeln, und durch die vier anderen die hinteren Schultermuskeln an einer zweiten Leiche bearbeiten und habe dadurch die Möglichkeit den Brustschulterapparat in der Lehrunterredung einheitlich behandeln zu können. Oder ich lasse von vier Leuten an einem Präparat die Dammgegend von unten her darstellen, während vier andere gleichzeitig an einem zweiten Objekt die Präparation des kleinem Beckens von oben her ausführen. Die beiden Halbgruppen haben ein selbstverständ-

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liches Interesse sich gegenseitig von ihren Erkenntnissen zu belehren und so zu synthetischem Erfassen zu kommen. In der Lehrunterredung kann dieses noch vertieft werden. In solcher Ergänzungsarbeit kann ein ziemlich flottes Tempo der Arbeiten erreicht werden, ohne dass die Gründlichkeit des Durcharbeitens leidet. Die Studierenden lieben die zur mehr technischen Arbeit gehörigen Lehrunterredungen sehr

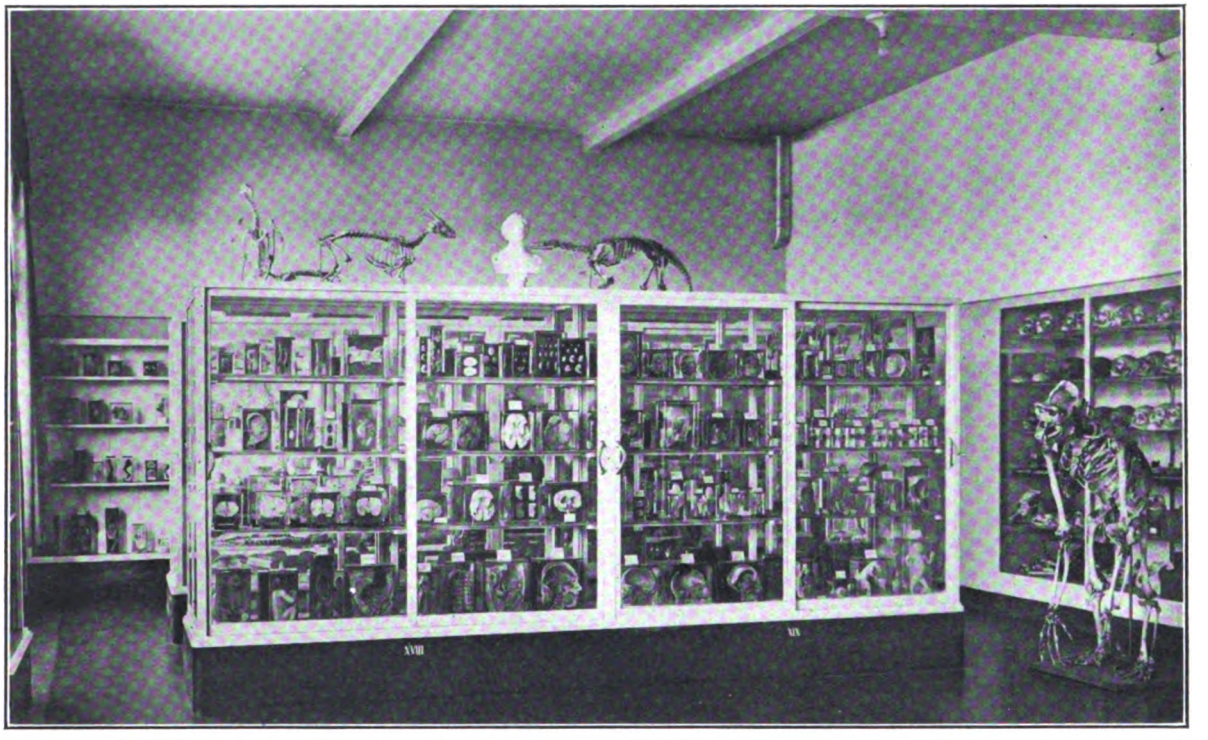

FIG. 15.—SAMMLUNGSRAUM IM OBERGESCHOSS

und meistens sind die Resultate derselben ganz ordentlich. Freilich der Lehrkörper wird dadurch stark belastet. Fanden doch in manchen Semestern bis zu dreissig Stunden Lehrunterredungen pro Woche statt, wobei selbstverständlich gleichzeitig mehrere Räume in Anspruch genommen werden mussten, und zahlreiche Lehrkräfte von den Professoren bis zu „älteren Studierenden" sich beteiligten. Dass neben diesen Lehrunterredungen sich die Lehrkräfte auch helfend und erläuternd auf dem Präpariersaal beteiligen ist selbstverständlich.

In dem mikroskopischen Kursus, wo es sich darum handelt die Studenten durch selbstständige Übung mit dem Mikroskop gründlich vertraut zu machen, praktische Fertigkeit im Erkennen der Zellstructuren und Gewebsbesonderheiten zu gewinnen, sowie in den mikroskopischen Aufbau der Organe einzudringen, fangen wir gewöhnlich so an, dass ein einfaches Organ den Ausgangspunkt abgibt und dann Spezialpräparate, die an ihm besonders hervorstechenden Gewebe genauer erläutern. Die feineren Zellstrukturen kommen erst zur Behandlung, nachdem eine gewisse Fertigkeit im Erkennen der Gewebe erlangt ist. Die meisten mikroskopischen Präparate liefern wir den Studierenden fertig, ein kleinerer Teil muss von ihnen selbst hergestellt werden, so dass sie die elementare Mikrotechnik kennen lernen. Für ältere Studierende ist auch schon öfters ein besonderer Kurs entwickelungsgeschichtlicher Art abgehalten worden.

Studierende, welche die Anfängerkurse absolviert haben, können in den Laboratorien des wissenschaftlichen Institutsteiles besondere Aufgaben gestellt bekommen. Meist handelt es sich dabei um Fragen die der vergleichenden Anatomie oder Entwickelungsgeschichte angehören. Eine Reihe wertvoller Schülerarbeiten ist in den letzten Jahren enstanden, wovon bisher erst ein Teil im Druck erscheinen konnte.

Im allgemeinen wird am Institut auch der wissenschaftlichen Arbeit gegenüber der Grundsatz lieber wenig Gründliches, als viel Oberflächliches festgehalten. Die Wissenschaften schreiten

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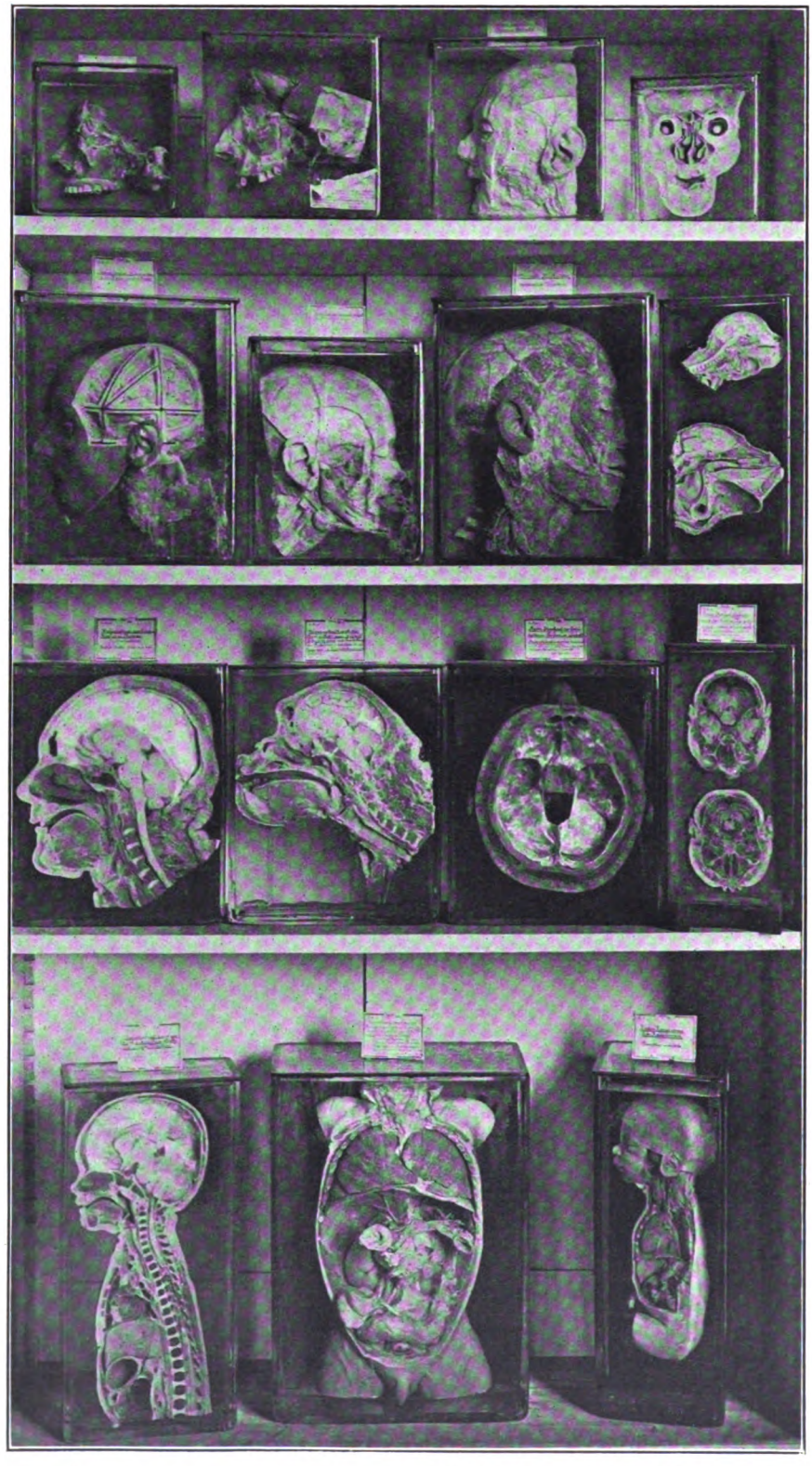

FIG. 16.—SAMMLUNGSREGAL MIT PRÄPARATEN DIE IM INSTITUT ANGEFERTIGT WORDEN SIND

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fort, viel weniger durch Expansion in die Breite, als durch Solidität und Tiefenfundierung. Wir haben auf vielen Gebieten der Wissenschaften eine Periode hinter uns, die diesen Grundsätzen nicht entsprach. Daher auch die in Europa deutlich merkbare Krise der Wissenschaft, welche durchaus nicht nur materieller Art ist, wie oberflächliche Beobachter leicht annehmen. Es sind am Institut auch in den allerschwersten Zeiten der Überlastung mit Unterrichtsleistungen, wie solches nach Abschluss des Krieges der Fall war, schaftliche Leistungen, das in den Vordergrund stellten, was heute das Wichtigste sein muss, der Jugend eines schwergeprüften und schwerringenden Volkes den Segen stiller, tiefgründiger und weitblickender Wissenschaft zu vollem Bewusstsein zu bringen. Wir setzten unsere Ehre darein eine Werkstätte der gemeinsamen Arbeit von Jung und Alt zu sein, im Sinne jener Schulen der Wissenschaft in der Vergangenheit, die nicht nur um den Stoff der Wissenschaften, sondern um die geistige Menschengestaltung sich mühten. Die

FIG. 17.—ASSISTENTENZIMMER

und in der Inflationsperiode, die jedem deutschen Forscher schwerste Sorgen brachte und ihn einer ganz ungewissen Zukunft gegenüberstellte, stille Arbeiten grösseren Umfanges durchgeführt worden, die zum grössten Teil erst im Lauf der kommenden Jahre der wissenschaftlichen Welt vorgelegt werden sollen. Dankbar sei der vielen, äusserlich wenig auffälligen Arbeit gedacht, welcher sich der für die Grösse des Institutes sehr kleine Stab an wissenschaftlichen Arbeitern und Hülfskräften unterwarf, um unter schwierigsten Verhältnissen, das Institut wenigstens als Lehranstalt möglichst schnell auf eine beachtenswerte Stufe zu heben. Ich gebe gerne zu, dass fast alle Mitarbeiter ihr Bestes eingesetzt haben und manchmal unter Verzicht auf rasche wissen-

Wissenschaft darf, will sie ihre Aufgabe mit grösstem Nutzen für die Menschheit erfüllen, nicht den Anspruch machen ein Sonderleben ganz für sich zu führen. Sie steht mitten in dem Geschehen der Zeiten und hat in diesem eine Rolle von eminenter Bedeutung zu erfüllen. Sie mag den Anspruch machen in letzter Linie für die unendliche Wahrheit zu wirken, in nächstliegender Beziehung arbeitet sie auf allen ihren Teilgebieten für die Mehrung der Wahrhaftigkeit in den Menschen ihrer Zeit und ihres unmittelbaren Wirkungsbereiches. Institute, die so sehr durch den Geist, in dem sie lehren, Einfluss haben auf die Erziehung der kommenden Generation von Ärzten, also von Helfern und Heilern, wie die anatomischen Anstalten, auf denen die

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Jugend längere Semester hindurch sich Belehrung und Anregung holt, dürfen, wenn sie nicht grosse wissenschaftliche Stäbe haben, und das ist eben hier in Frankfurt nicht der Fall, die Forschungsaufgabe nicht über die Lehraufgabe überwuchern lassen, ohne ihre Pflicht der Jugend gegenüber zu vernachlässigen. Von der Jugend und ihrem Geiste aber hängt die Zukunft eines Volkes, und ebenso die Zukunft der Menschheit ab.

Aus ähnlichem Grunde hat sich das Institut seit seinem Bestehen auch ernstlich für die allgemeine Volksbildung eingesetzt. Neben besonderen Unterrichtskursen für Turnlehrer und Sportsleute, neben Vortragscyklen für Künstler und Kunstschüler, sind fast jedes Jahr auch Vortragsserien für den Frankfurter Bund für Volksbildung abgehalten worden. Sie haben die verschiedenartigsten Fragen aus der physischen Organisation des Menschen, aus seiner Geschichte und jener der lebendigen Wesen überhaupt betroffen. Auch die Vorbereitung dieser Kurse und ihre Durchführung wird sehr ernst genommen. Mit seichtem Popularisieren dient die Wissenschaft dem Volke schlecht. Vielmehr hat sie in bescheidener Weise für die vielen Wahrheiten zu zeugen, die erst in der geistigen Natur des Menschen sich als Glieder der einen, unendlichen, nie voll ergründbaren Wahrheit zusammenfinden.

DER STAB DER MITARBEITER

Der wissenschaftliche Stab besteht aus einem Direktor, der zugleich ordentlicher Professor für das Gesamtgebiet der Anatomie und Entwickelungsgeschichte ist, dann aus einem Abteilungsvorsteher und Prosektor, zugleich zweiter Vortragender, ferner aus zwei Assistenten. Für den Unterricht in praktischen Kursen werden stets je nach Bedarf ältere Studierende als Demonstratoren und Repetitoren herangezogen, die nicht besoldet werden.

Für die Anfertigung mikroskopischer Präparate und Hülfsarbeiten büromässiger Art ist eine Laboratoriumsassistentin angestellt.

Für die übrigen zumeist technischen Arbeiten sind drei Institutsgehülfen, für Reinigungsarbeiten eine Putzfrau tätig.

Die Zahl der Mitarbeiter und Hülfskräfte ist für die Grösse des Institutes sehr gering und jedes einzelne Glied muss fleissig arbeiten, um mit seinem Arbeitspensum fertig werden zu können.

DAS BUDGET

In der Inflationszeit waren die Finanzverhältnisse des Institutes sehr wenig übersichtlich. Nur eines sei betont, es wurde mächtig gespart, oft mehr als dem Institut und seiner Aufgabe zuträglich gewesen sein mag. Auch jetzt noch liegen die Finanzverhältnisse ausserordentlich bescheiden, die Gehälter haben kaum, die Löhne noch weniger die Massstäbe der Friedenszeit erreicht und für sachliche Ausgaben stehen nur etwa zwei Drittel der früher bewilligten Mittel zur Verfügung.

Für das Rechnungsjahr 1924 (1. April 1924-31. März 1925) betragen die bewilligten Mittel:

	Mark
Für den wissenschaftlichen Stab...	24 900
Für die Hülfskräfte.....	6 100
Für sachliche Zwecke (Gesamtausgaben für den Betrieb, incl. Heizung und Beleuchtung, Gebäudeunterhalt, Bücher und wissenschaftliche Arbeiten)	9 500

Es ergibt sich also gegenwärtig eine jährliche Gesamtausgabe von 40 500 M. oder rund 10 000 amerikanischen Dollar.

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L'INSTITUT D'ANATOMIE
DE
L'UNIVERSITÉ DE STRASBOURG

PAR
ANDRÉ FORSTER, DIRECTEUR
PROFESSEUR D'ANATOMIE

DESCRIPTION DU BÂTIMENT

Le bâtiment dans lequel se trouve actuellement l'Institut d'anatomie normale fut construit et aménagé dans les années 1875 et 1876. Dès sa fondation il était destiné à abriter les locaux universitaires réservés à toutes les sciences morphologiques enseignées à la Faculté de Médecine. C'est ainsi que l'aile droite du bâtiment, grand hexagone, rappelant la forme d'un bastion, avec cour intérieure, était exclusivement occupée par l'anatomie pathologique. Seule l'aile gauche revenait par destination à l'anatomie normale.

Ce dispositif répondait, à l'époque, aux exigences de l'enseignement ainsi que des recherches scientifiques. Aucune division bien prononcée n'était encore établie dans le domaine de l'anatomie. C'est donc dans l'aile gauche de ce bâtiment, entourant une cour intérieure, assez vaste, et qui comporte, à sa façade de devant, un simple rez-de-chaussée et un sous-sol, sur ses côtés, en plus, un premier étage et, sur sa façade de derrière, en plus encore, un deuxième étage, que se trouvait à la fois l'emplacement de l'anatomie normale et de l'histologie. La juxtaposition de ces deux services dans un local destiné à un seul

FIG. 1.—FAÇADE DU BÂTIMENT DE L'ANATOMIE

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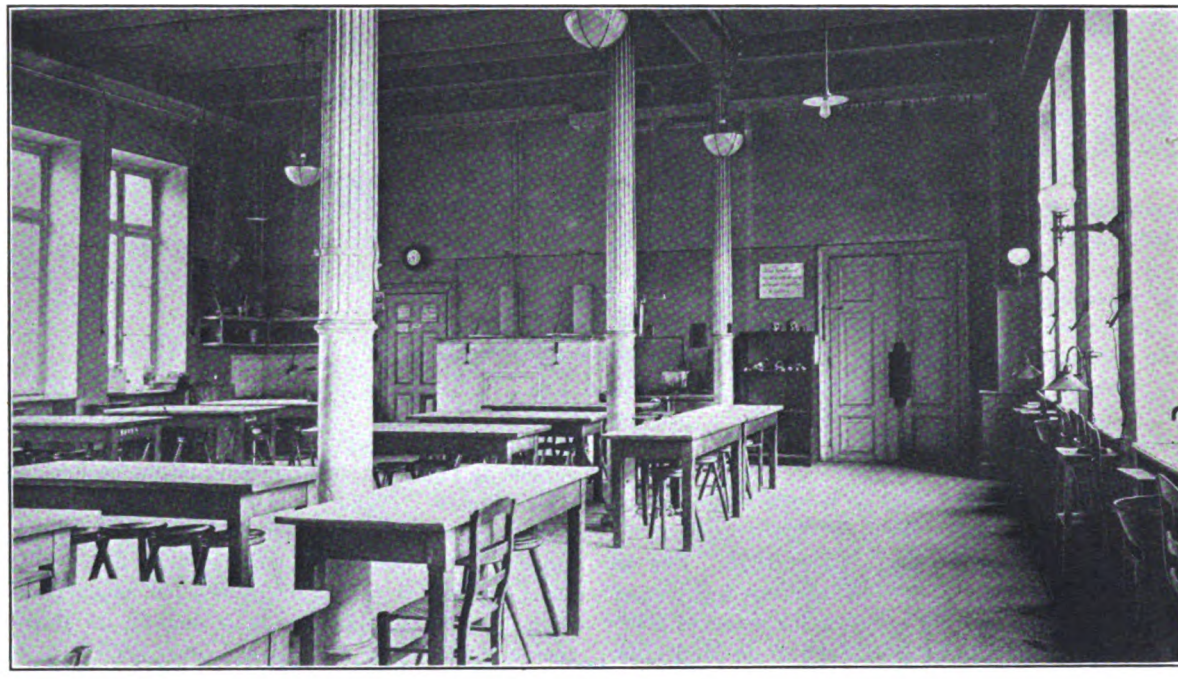

FIG. 2.—PREMIÈRE SALLE DE DISSECTION

a eu pour résultat de les resserrer considérablement et souvent même de les enchevêtrer. Un coup d'œil jeté sur les deux plans que nous ajoutons à notre description montre immédiatement le mélange des deux services, ayant au surplus un certain nombre de locaux communs.

La façade de devant mesure en longueur 42,5 mètres (au total pour les deux ailes 85 mètres) ; les deux façades latérales ont 36 et 40 mètres. La façade postérieure, plus petite dans son ensemble, n'est que de 24 mètres, sur lesquels 12 mètres, donc la moitié, reviennent à l'anatomie normale.

Libre de tous les côtés, le bâtiment est bien éclairé. Toutefois, l'orientation de l'édifice laisse à désirer; il y a là un défaut très important, qui se comprend d'ailleurs assez facilement si l'on songe qu'à l'époque de la construction, on n'attachait pas une importance capitale à l'histologie et par le fait même à l'éclairage.

LES SOUS-SOLS

Les sous-sols comprennent tout d'abord à l'entrée du bâtiment, la loge du portier avec débarras, puis les chambres de conservation du matériel anatomique destiné à l'enseignement: pièces détachées, d'une part, conservées dans des récipients émaillés ; corps entiers, d'autre part, très bien conservés dans des cuves cimentées; une chambre réservée à l'injection des pièces anatomiques et des corps entiers; l'atelier du garçon de laboratoire; la salle du transformateur électrique actionnant les appareils à projection des divers services du bâtiment; une salle de répétition pour les étudiants; une buanderie; une pièce pour petits animaux de laboratoire (service de l'histologie) ; enfin le monte-charge pour le transfert des corps du rez-de-chaussée à la salle des travaux pratiques, les caves à charbons et les calorifères.

Ce genre de chauffage est resté inchangé depuis la construction du bâtiment, en sorte qu'il ne répond plus, par son installation à air chaud, à la nécessité du moment. Insuffisants dans leur ensemble, malgré les quatre foyers de chaufferie, il a fallu suppléer au fonctionnement défectueux de ces calorifères par l'installation de nombreux fourneaux supplémentaires. Inutile d'ajouter que ce mode de chauffage est particulièrement onéreux, tout en nuisant à l'hygiène des locaux.

REZ-DE-CHAUSSÉE

Au rez-de-chaussée, l'unique place réservée au service de l'anatomie normale est représentée par les salles de travaux pratiques des étudiants, le laboratoire des aides d'anatomie, celui du chargé de cours et le petit atelier du garçon de laboratoire. Tout le reste de l'étage, à l'exception d'une toute petite chambre à photographie, occupée en commun avec le service d'histologie, est réservé à ce dernier service, dont les locaux sont dissé-

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minés aussi bien sur la façade postérieure que sur la façade antérieure et partiellement sur les côtés du bâtiment, et se trouvent séparés par la cour.

Les salles de travaux pratiques sont au nombre de deux, reliées l'une et l'autre par un petit couloir dans lequel donnent le laboratoire des aides d'anatomie et le monte-charge venant du sous-sol. La surveillance est donc garantie et le matériel peut ainsi facilement être amené et distribué. La plus grande des deux salles mesurant 12,5 mètres sur 10 mètres est destinée aux étudiants de première année de médecine, travaillant sur des corps entiers pour la dissection des membres et de la musculature du tronc. L'éclairage naturel se fait sur les deux grands côtés, de telle sorte qu'une bonne clarté est répartie dans toute la salle. L'éclairage artificiel est indirect et se trouve produit par 6 puissantes lampes électriques de 800 bougies chacune: la lumière est projetée tout d'abord vers le plafond et revient diffuse sur les tables. La plus petite salle de 10,5 mètres sur 5,5 mètres est moins bien aménagée non pas quant à l'éclairage artificiel, mais surtout en ce qui concerne l'éclairage naturel, provenant uniquement de deux côtés d'angle. Les étudiants de 2ème année y disséquent les viscères, le cerveau, les nerfs crâniens et font des préparations topographiques sur pièces détachées. Dans cette salle se font également les démonstrations topographiques sur sujets entiers. La seconde salle de travaux pratiques doit donc suffire à un double emploi.

Le travail de dissection se fait sur de grandes tables rectangulaires de deux mètres de long sur un mètre de largeur en chêne massif, sur lesquelles sont directement posés les corps entiers après avoir été égouttés soigneusement. Pour les pièces séparées on emploie par contre, et en surplus, de petits plateaux en bois ou en zinc. Les tables en chêne ont l'avantage de ne donner aucune sensation de froid aux étudiants quand ils y posent leurs mains et leurs bras. Lavées tous les jours à la soude et particulièrement nettoyées tous les samedis, ces tables sont maintenues très proprement. En effet, les corps sont enlevés tous les soirs et sont transportés dans le sous-sol. Les pièces détachées sont suspendues dans de grands récipients garnis de zinc à l'intérieur et disposés, dans les deux salles, tout-à-fait à la portée des étudiants. Il n'existe aucun appareil d'épi- ou de dia-scopie ni dans l'une ni dans l'autre salle. Le travail doit donc, pour devenir profitable, être suivi par le personnel enseignant. Il n'existe aucune installation radioscopique.

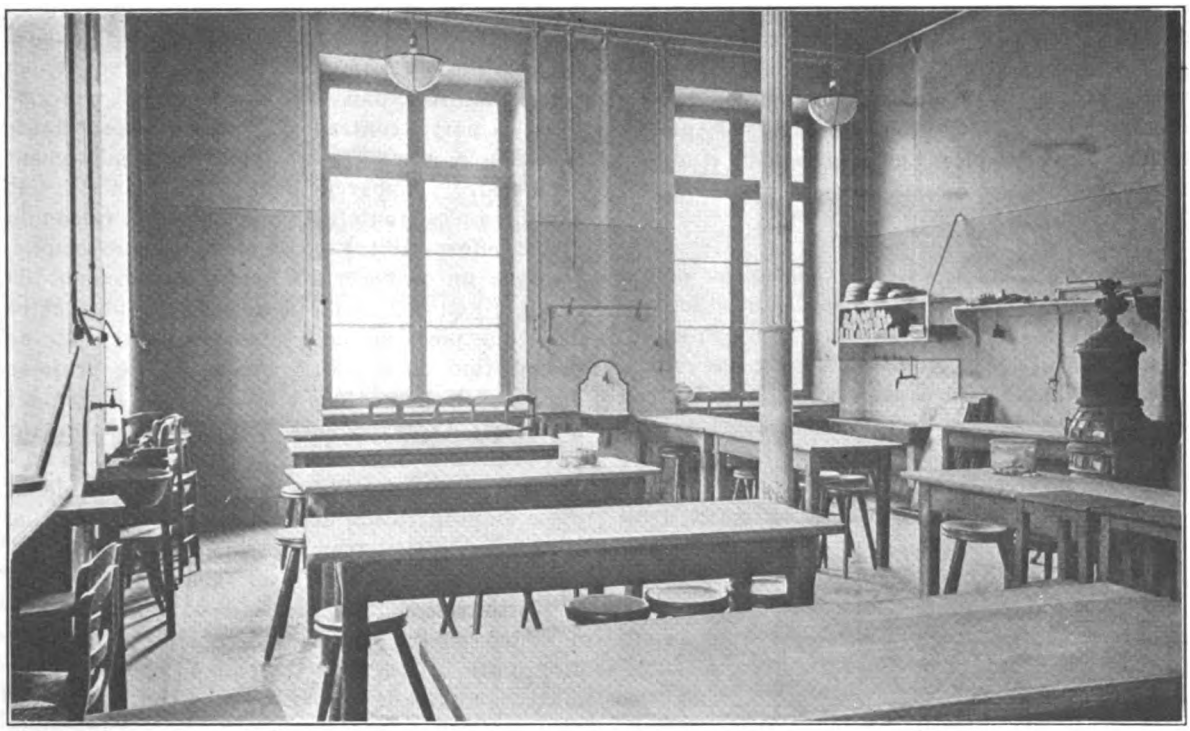

FIG. 3.—DEUXIÈME SALLE DE DISSECTION

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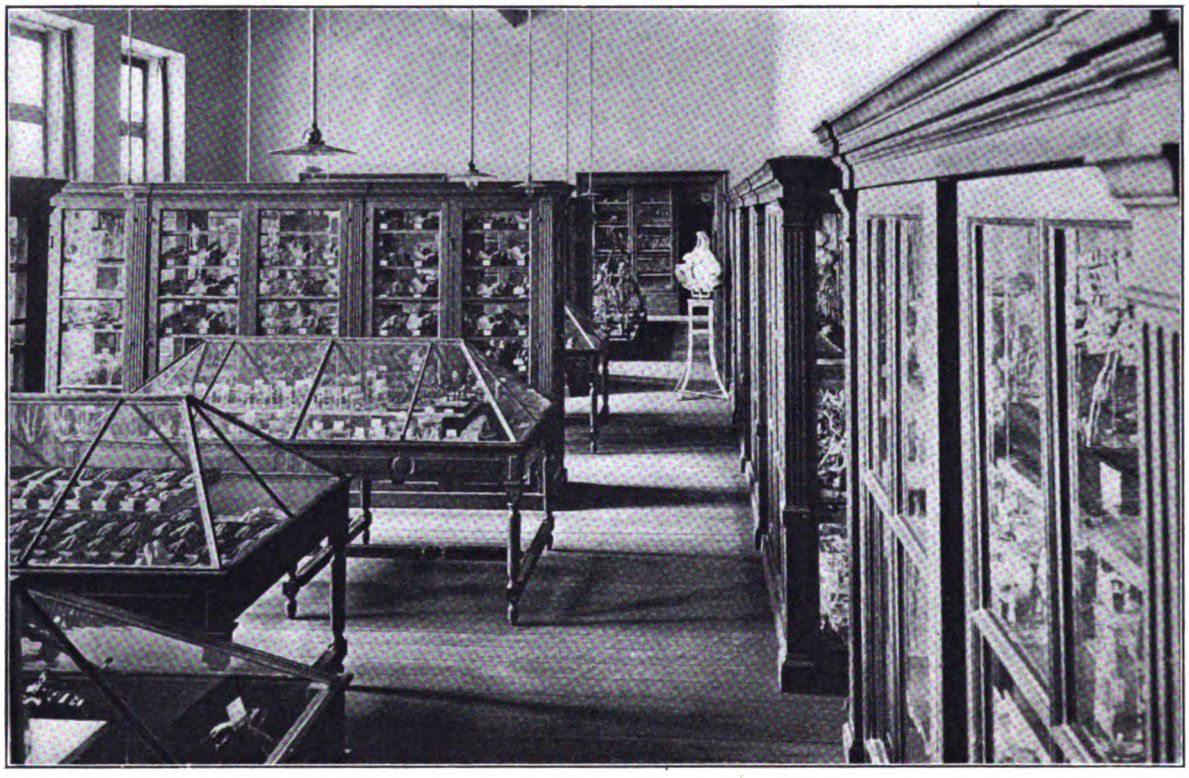

FIG. 4.—MUSÉE D'ANATOMIE

Les lavabos à eau chaude et eau froide ainsi que le vestiaire et les casiers réservés aux étudiants se trouvent dans le grand couloir de dégagement desservant l'arrière du bâtiment (contenant en majeure partie des locaux réservés aux besoins de l'histologie). Il n'y a pas jusqu'à nouvel ordre d'emplacement séparé pour étudiants et étudiantes.

PREMIER ÉTAGE

Le premier étage est principalement occupé par l'amphithéâtre et les salles de collections de l'anatomie, en outre par le cabinet du professeur et son laboratoire particulier, le petit laboratoire des aides d'anatomie et du chef des travaux, la petite bibliothèque et un atelier du 2ème garçon.

L'amphithéâtre, situé dans la partie postérieure du bâtiment, en occupe la partie centrale. On y accède par un vaste escalier après avoir traversé la cour intérieure. Cette salle comporte normalement 120 places et est commune au service d'histologie, d'anatomie pathologique et de médecine légale. Les sièges sont répartis sur 11 bancs pas très fortement surélevés les uns au-dessus des autres. C'est ainsi que la salle est relativement profonde tout en étant élevée. L'éclairage se fait par un côté seulement à l'aide de très vastes ouvertures. Un appareil à dia- et épi-scopie y est installé, et, pour ne pas troubler l'aspect et le dispositif général de la salle, cet appareil se trouve remisé, en temps habituel, dans le sous-bassement des gradins: la partie centrale des trois premiers bancs est mobile, en sorte qu'après leur enlèvement temporaire, l'appareil peut être avancé. Cet avantage n'est toutefois qu'apparent en raison du grand effort qu'il suppose pour chaque emploi, et c'est un fait certain que l'emplacement de l'appareil en dehors de la salle de l'amphithéâtre dans une pièce spéciale (dans la petite salle de préparation du cours), permettant de projeter l'image à la portée des étudiants, est infiniment meilleur. Cette organisation n'étant cependant pas réalisable dans notre cas particulier en raison des dimensions par trop restreintes de la pièce de préparation des cours, on a trouvé utile, à l'époque, d'appliquer l'installation décrite.

La ou, pour mieux dire, les salles de collections, qui, primitivement séparées (38 et 39 du Plan II), ont depuis été réunies, occupent pour ainsi dire toute la longueur du pan oblique du bâtiment: longues de 28 mètres environ, ces salles abritent une partie de la collection d'anatomie comparée (specialement des pièces sèches) et les

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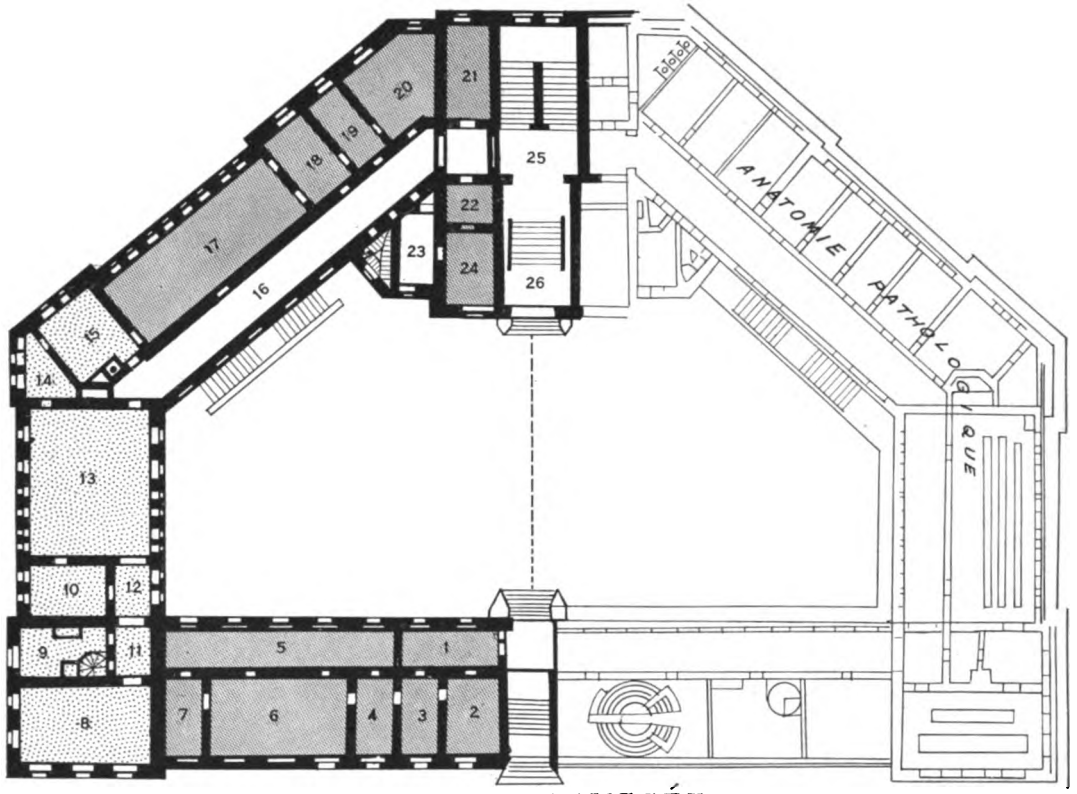

REZ-DE-CHAUSSÉE

PLAN I

HISTOLOGIE ANATOMIE NORMALE LOCAUX COMMUNS

1. Antichambre
2. Laboratoire du professeur
3. Cabinet et bibliothèque du professeur
4. Cabinet du 2ème préparateur
5. Couloir transformé en laboratoire
6. Laboratoire commun et salle de matériel
7. Cabinet du 1er préparateur
8. Salle des travaux pratiques
9. Salle de préparation (monte-charge)
10. Laboratoire des moniteurs d'anatomie
11. Couloir
12. Couloir
13. Salle des travaux pratiques
14. Laboratoire de garçon d'anatomie
15. Laboratoire du chargé de cours
16. Couloir
17. Salle de travaux pratiques (élèves)
18. Salle de préparations et collections
19. Salle d'élevage pour petits animaux
20. Salle d'expérimentations et de chimie
21. Salle conservations de planches murales; élevage de petits animaux
22. Cabinet du chargé de cours
23. Chambre de photographie
24. Cabinet du chargé de cours
25. Cage d'escalier
26. Cage d'escalier

FIG. 5

nombreuses unités que comporte l'anatomie descriptive humaine (suite de moulages en plâtre, pièces humides conservées dans de l'alcool et pièces sèches). En outre des éléments strictement nécessaires à l'enseignement, nous y trouvons des pièces documentaires de travaux scientifiques en grand nombre, tel qu'une série très complète de squelettes de mains et de pieds, tous macérés et montés par le professeur Pfitzner et signalant une multitude de variations du carpe et du tarse, ensuite une série très étendue de variétés artérielles, enfin un grand nombre de pièces de valeur historique portant sur des injections de vaisseaux lymphatiques au mercure et sur injection des voies séminifères (Lauth). Les collections de l'anatomie humaine sont de telle

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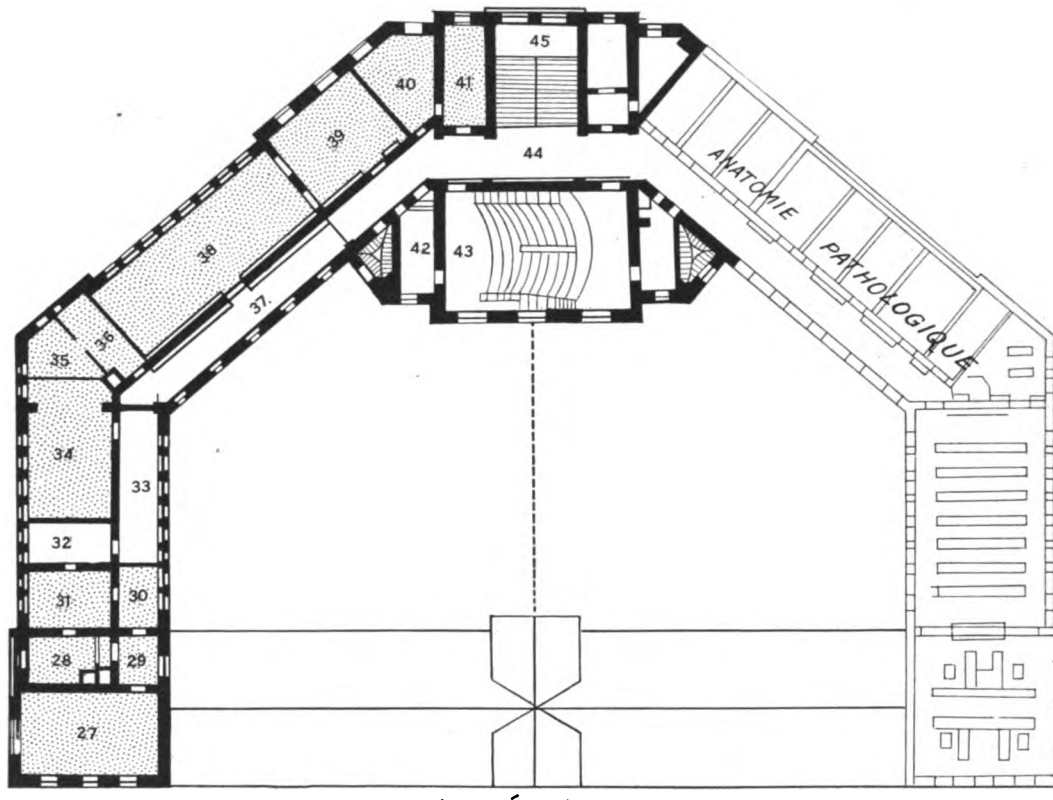

1er ÉTAGE

PLAN II

ANATOMIE NORMALE — LOCAUX COMMUNS

27. Collection d'anthropologie
28. Cabinet du professeur
29. Couloir
30. Couloir
31. Laboratoire du professeur
32. Bibliothèque
33. Couloir avec tables de travail
34. Laboratoire des aides d'anatomie
35. Débarras
36. Verrerie
37. Couloir avec tables de travail
38. Collection d'anatomie descriptive
39. Collection d'anatomie comparée
40. Laboratoire du 2ème garçon
41. Laboratoire du chef des travaux
42. Salle de préparations des cours
43. Amphithéâtre
44. Couloir
45. Cage d'escalier

FIG. 6

importance que toutes les pièces topographiques, parmi lesquelles comptent surtout les merveilleux documents de Joessel, sont placées dans le couloir (33 et 37) le long des murs. Il en est de même de la collection d'anatomie comparée (de pièces humides et très intérressante dans son ensemble). Enfin une grande place est réservée aux collections anthropologiques (27, 29, et 30). Plus de 1,400 crânes de toutes provenances sont sérieusement catalogués. Nous y trouvons une grande série de squelettes humains de diverses races, soit détachés, soit montés; nous y possédons enfin une collection de crânes d'enfants de tous les âges (matériel très difficile à obtenir), et une série de crânes simiens d'espèces très variées, avec les cerveaux correspondants, conservés dans de l'alcool. Un grand nombre de squelettes entiers de simiens et de prosimiens complètent nos collections, squelettes bruts permettant une utilisation très précieuse dans la recherche scientifique. Je n'ajoute que pour mémoire les moulages nombreux de documents préhistoriques se rapportant à toutes les pièces célèbres.

La masse de ces collections ne laisse, comme

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il est facile de le concevoir que très peu de place libre. C'est ainsi que la bibliothèque du laboratoire d'anatomie est excessivement à l'étroit. Bien fournie en périodiques français, anglais, américains et allemands, en traités et en ouvrages originaux, elle se trouve extrêmement resserrée dans une pièce de 3 mètres sur 7 mètres, tout en étant commune avec le service d'histologie. L'emplacement est restreint à un tel degré qu'il a fallu, pour l'agrandir, empiéter sur le laboratoire attenant des aides d'anatomie, et même de cette manière, l'installation est des plus modestes et ne présente aucun confort au lecteur.

Le cabinet du professeur et son laboratoire, le laboratoire des aides d'anatomie et l'atelier du garçon se partagent enfin le peu de place laissée inoccupée et se trouvent ainsi réduits à des installations modestes.

En résumé, le bâtiment de l'Institut d'anatomie marque bien et à tous les points de vue l'empreinte de l'âge. Construits à une époque relativement lointaine, à une époque où l'importance des sciences morphologiques n'avait pas encore atteint l'ampleur actuelle, tous les locaux sont devenus insuffisants et se compriment les uns les autres. Ce dernier effet s'est surtout fait sentir après la séparation complète du service de l'histologie de l'anatomie macroscopique qui favorisa essentiellement l'enchevêtrement des locaux, comme il vient d'être dit. Il a fallu faire emploi de tout et en particulier des couloirs, par exemple, pour subvenir aux nécessités premières des recherches, des collections et de l'enseignement. La place pour de jeunes chercheurs n'est plus facile à trouver ni au rez-de-chaussée, ni au premier étage, ni au second étage (dans la partie postérieure du bâtiment occupée par le logement du portier).

ORGANISATION DU TRAVAIL

Le travail qui s'effectue à l'Institut d'anatomie comprend, d'une part l'enseignement, rigoureusement adapté au programme des études de médecine et laissant une large place aux travaux pratiques, d'autre part la recherche scientifique.

En raison de l'important matériel d'anatomie comparée dont on dispose, c'est vers cette dernière que les chercheurs se trouvent plus particulièrement orientés. L'anatomie simienne est tout spécialement étudiée au point de vue des rapports qu'elle présente avec l'anatomie de l'homme. La collection anthropologique offre d'autre part toutes les possibilités de recherches orientées, soit vers la préhistoire, soit vers l'évolution plus récente de l'espèce humaine, soit vers les connexions qui existent entre elles et les espèces inférieures.

PERSONNEL

Un professeur: André Forster.

Un chargé de cours: Ph. Bellocq.

Un chef des travaux: (Dr en médecine) P. Hecker.

Deux aides d'anatomie (étudiants en médecine).

Deux moniteurs d'anatomie (étudiants en médecine).

Deux garçons d'anatomie.

Le professeur et le chargé de cours sont chargés de l'enseignement théorique. Le chef des travaux avec les aides et les moniteurs d'anatomie s'occupent exclusivement des manipulations des étudiants pendant les séances de dissection. Toutefois, le professeur et le chargé de cours prennent la part la plus active aux travaux pratiques. En réalité tous deux les dirigent complètement et y assistent d'une manière régulière avec tout le personnel, aidant les étudiants pendant toute la durée des séances et leur donnant toutes les indications utiles. C'est dire que professeur, chargé de cours et chef des travaux consacrent tout leur temps au service de l'Institut d'anatomie et à son bon fonctionnement, laissant de côté toute clientèle médicale.

MOYENS D'ACTION ET TRAITEMENTS

	Francs
Crédit de laboratoire	20.000
Traitements—salaires:	
Professeur, chargé de cours, chef des travaux:	
Traitements	40.000
Peréquation	10.000
Aides d'anatomie et moniteurs d'anatomie	4.400
Garçons d'anatomie	9.200
Total	83.600

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L'INSTITUT D'HISTOLOGIE
DE
L'UNIVERSITÉ DE STRASBOURG

PAR
P. BOUIN, DIRECTEUR
PROFESSEUR D'HISTOLOGIE

LOCAUX

Le service d'histologie comprend une série de pièces dont la plupart sont situées au rez-de-chaussée de l'ancien institut d'anatomie. Il compte en outre quelques locaux qui lui sont communs avec l'anatomie. Il renferme tout d'abord les salles du professeur, avec un cabinet-bibliothèque et un laboratoire de recherches (2 et 3, Plan I) ; la salle du deuxième préparateur (4) ; une grande pièce (6), ancienne salle de dissection, qui a été divisée en trois compartiments par deux cloisons incomplètes, avec rayons et tables de travail. Cette pièce sert de salle commune, de réserve pour le matériel, et de salle de recherches pour les travailleurs libres. Nous trouvons ensuite le cabinet du premier préparateur (7). Il donne dans un couloir qui se prolongeait tout le long de l'ancien institut d'anatomie (5 et 1). Ce boyau a été divisé en quatre logettes par des cloisons rayonnées, logettes qui jusqu'ici ont été occupées par huit travailleurs.

Il faut traverser la cour pour se rendre dans la deuxième partie de l'Institut d'histologie. Il comprend un laboratoire pour le chargé de cours, M. Max Aron (22 et 24) et trois pièces, dont deux servent à l'entretien des petits animaux, rats, souris, avec aquarium pour vertébrés aquatiques (19 et 21), et l'autre à la stérilisation, aux opérations pour recherches expérimentales, et aux manipulations de chimie pour recherches histo-chimiques (20). La salle de travaux pratiques leur fait suite (17 et 18). Elle est assez vaste; mais elle a le grand inconvénient d'être orientée au sud-est, et de manquer de lumière parcequ'elle est éclairée par des fenêtres trop étroites; les étudiants ne peuvent y pratiquer la plupart des manipulations histologiques, les commodités nécessaires n'ayant pas été prévues et ne pouvant être installées de façon convenable. Cette salle est munie depuis deux ans d'un appareil à microprojection de Leitz. Au même étage se trouve un petit local pour la photographie, que l'histologie possède en commun avec l'anatomie (23).

Le premier étage comporte les dépendances du service d'anatomie, avec le grand amphithéâtre et la bibliothèque commune, dont il a été question dans le rapport de M. Forster.

Des locaux accessoires sont annexés aux précédents. C'est tout d'abord une petite cave, dans le sous-sol, où nous gardons des animaux, une salle pour rayons X, située assez loin de notre institut, dans le sous-sol du service de radiologie (M. Gunsett) ; enfin des installations pour animaux, qui sont rudimentaires, car elles consistent en baraques en planches et parcs à volailles, édifiées par nos propres moyens dans le voisinage de l'Institut d'anatomie.

L'Institut d'histologie est donc installé d'une façon qui rend l'enseignement pratique et les recherches assez difficiles, et qui n'est pas en rapport avec les exigences de la science moderne.

MÉTHODES D'ENSEIGNEMENT

L'enseignement de l'histologie est depuis longtemps séparé de celui de l'anatomie dans les facultés françaises, et l'on a appliqué la même conception pour la faculté de Strasbourg. L'expérience s'est prononcée en faveur de cette séparation. Les tendances de l'histologie l'orientent de plus en plus vers les problèmes biologiques généraux et la physiologie cellulaire. Science exclusivement descriptive hier, parcequ'elle était anatomique dans son esprit, elle devient aujourd'hui une science expérimentale et une des branches les plus importantes de la biologie générale. Les résultats obtenus en peu d'années par les recherches faites dans cette direction font prévoir le grand développement qu'elle prendra dans l'avenir.

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Ces deux tendances de l'anatomie et de l'histologie expliquent déjà la séparation des deux disciplines. Cette séparation est tout aussi avantageuse au point de vue de l'enseignement. L'indépendance du professeur d'histologie lui permet de rapprocher, dans ses leçons, des tissus et organes qui ont une structure et une fonction analogues, de montrer leurs relations réciproques au point de vue morphologique et fonctionnel, de la division cellulaire avec la régénération et la croissance, les facteurs qui agissent sur la division cellulaire, les tactismes et les tropismes, les actions morphogénétiques des sécrétions internes, la physiologie cellulaire. . . . On peut organiser les leçons d'histologie de façon à rencontrer ces sujets, qui sont traités le plus souvent sans détails. Mais les étudiants y portent beaucoup d'intérêt, comme le témoignent les explica-

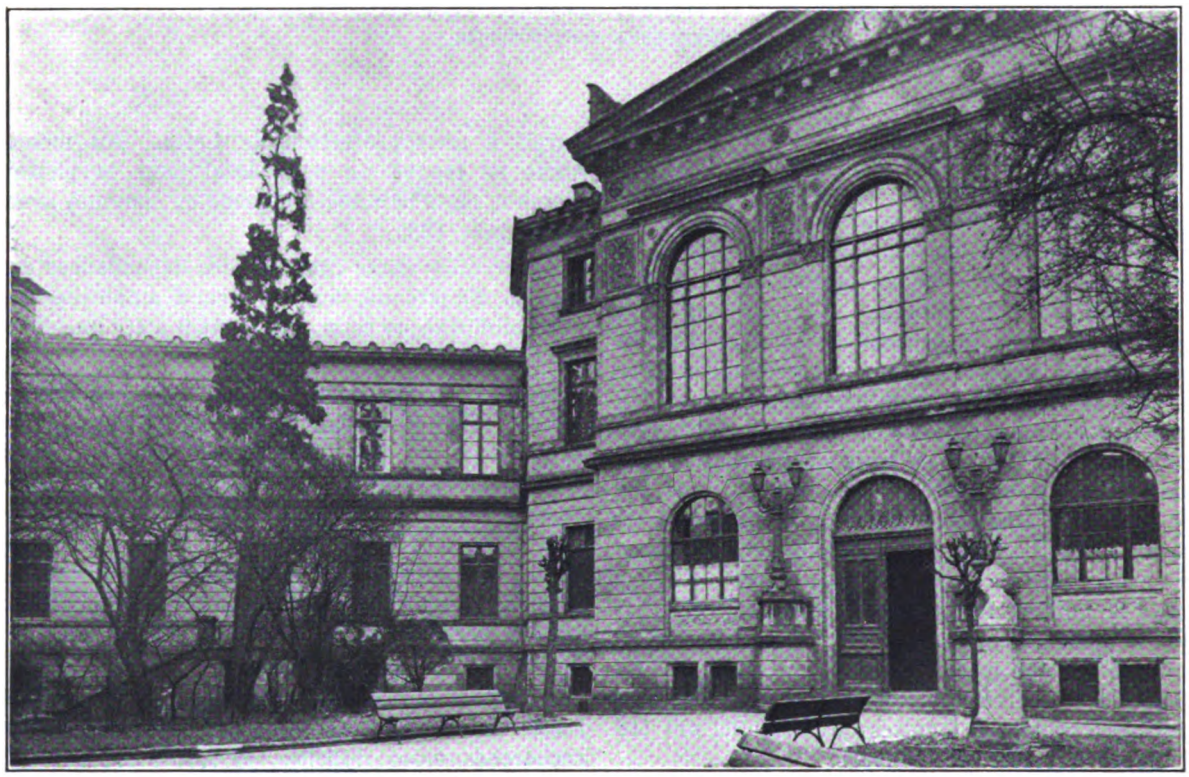

FIG. 1.—COUR INTÉRIEURE DU BÂTIMENT DE L'ANATOMIE

donner aux étudiants des vues d'ensemble et de leur présenter des synthèses. Elle lui permet en outre d'organiser ses leçons de façon à insister sur les sujets qui sont susceptibles d'ouvrir l'esprit des étudiants à la curiosité scientifique et aux principaux problèmes biologiques. Il est évident que dans une faculté de médecine, qui est avant tout une école professionnelle, nous ne pouvons donner beaucoup de temps à de semblables sujets. Mais nous croyons utile de faire prendre contact aux étudiants avec des questions comme la fécondation et l'activation de l'œuf, les localisations germinales et la différenciation cellulaire, l'hérédité et ses supports matériels, la détermination du sexe, les caractères sexuels, tions complémentaires qu'ils viennent solliciter et leur désir de faire des recherches dans les laboratoires. Nous pensons ici que c'est la meilleure méthode pour orienter les esprits vers la culture scientifique et pour assurer le bon recrutement du futur personnel enseignant. Nous constatons d'ailleurs que ceux qui souhaiteraient se consacrer à la science sont très nombreux. Ils en sont presque toujours empêchés par des raisons matérielles.

L'enseignement de l'histologie comporte deux parties, l'une théorique et l'autre pratique. La première est donnée par un professeur titulaire et un chargé de cours, aidés de deux préparateurs et de deux moniteurs. Il dure deux semestres,

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les premiers semestres des deux premières années des études médicales. Les étudiants entendent par semaine cinq leçons d'histologie. On peut ainsi leur donner un enseignement complet. L'enseignement pratique suit le cours théorique; il est destiné à en être pour ainsi dire l'illustration. Les étudiants du premier semestre assistent à deux séances d'exercices pratiques par semaine. La première est consacrée à l'étude de préparations toutes faites, portant sur les matières qui viennent d'être exposées dans les leçons théoriques. Au commencement de la séance, ces préparations sont projetées avec l'appareil à microprojection et expliquées aux étudiants. Ceux-ci les examinent ensuite au microscope et les dessinent; ils ont à leur disposition un exposé sommaire polygraphié de ce qu'ils doivent observer et reproduire. Notre installation insuffisante ne nous permet que rarement de leur faire exécuter à eux-mêmes des préparations microscopiques. La deuxième séance est une séance de démonstrations, destinée à leur faire voir des préparations spéciales, de cytologie ou d'organes modifiés par des expérimentations, par exemple. Chacune d'elles est accompagnée d'une notice explicative. Ces séances de démonstration sont apréciées des étudiants et donnent de très bons résultats. Les étudiants de deuxième année ne viennent qu'une seule fois par semaine aux travaux pratiques; ils assistent surtout aux séances de démonstration. Enfin les étudiants qui veulent se perfectionner soit en technique histologique, soit dans la connaissance des préparations, peuvent venir au laboratoire pendant leurs moments de liberté. Le matériel nécessaire et les collections sont mis à leur disposition. Nous allons voir ci-après que l'enseignement de l'histologie se tient en rapport étroit avec celui des autres branches morphologiques.

RELATIONS ENTRE L'ANATOMIE, L'HISTOLOGIE ET L'EMBRYOLOGIE

Bien que ces trois disciplines soient séparées au point de vue des locaux et du personnel, elles restent en rapport constant les unes avec les autres. Les professeurs d'anatomie et d'histologie notamment se mettent d'accord sur les programmes annuels. Les leçons d'anatomie et d'histologie sont faites parallèlement, et autant que possible de telle sorte que la description anatomique des organes précède l'étude de leur structure. Pour ce qui concerne le système nerveux, l'histologie enseigne seulement la morphologie générale des éléments nerveux. Le professeur d'anatomie les met en place dans les centres et enseigne la systématisation nerveuse. C'est là le point le plus délicat des connexions à établir entre les deux enseignements, et il demande beaucoup d'attention. Il en est de même pour les organes des sens.

L'embryologie est enseignée dans le deuxième semestre de la deuxième année d'études. Cet enseignement est fait quand celui de l'anatomie est entièrement terminé. L'embryologie, surtout l'organogénie, ne peut en effet être bien comprise que par des esprits préparés par l'étude de l'anatomie. Les étudiants suivent avec clarté l'évolution des ébauches embryologiques parcequ'ils en comprennent d'avance la signification et la destinée. Partout en France, l'embryologie est demeurée rattachée à l'anatomie et à l'histologie, sauf à Strasbourg où l'on fait l'essai d'un enseignement séparé. Il semble que les résultats sont en faveur de l'autonomie de l'embryologie, car la préparation des pièces, moulages, reconstructions, collections de préparations macro- et microscopiques ne peuvent être realisées que par un personnel spécialisé. Le professeur fait par semaine trois leçons d'embryologie pendant un semestre, et les étudiants suivent des exercices pratiques à raison d'une séance par semaine. Peut-être serons nous amenés à modifier les rapports de l'embryologie avec l'anatomie et l'histologie, et à faire faire par exemple l'embryologie générale au début des études morphologiques, et à laisser pour la fin de ces études l'embryologie spéciale ou organogénie.

SUJETS DE RECHERCHES POURSUIVIES À L'INSTITUT D'HISTOLOGIE

Le personnel qui travaille dans le laboratoire d'histologie a été orienté vers les recherches de cytologie, d'histologie expérimentale et de biologie générale. La plupart des recherches faites jusqu'ici ont porté sur les glandes à sécrétion interne et leur action sur les organes réactionnels. On étudie surtout les glandes endocrines génitales, leur action générale et plus particulièrement leur action sur les caractères sexuels. On cherche à montrer que cette action, chez le mâle, est toujours exercée par des cellules endocriniennes spécialisées et à étendre les anciens résultats obtenus par nous chez les mam-

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FIG. 2.—SALLE DE RECHERCHE EN HISTOLOGIE

mifères, à toutes les classes des vertébrés et même aux invertébrés: les oiseaux, reptiles, batraciens et poissons sont étudiés à ce point de vue par une série de chercheurs. Nos études anciennes sur les mammifères domestiques sont elles aussi complétées par des recherches sur les mammifères sauvages à activité sexuelle périodique. L'étude de la femelle est commencée au même point de vue.

M. P. Bouin, professeur, continue ses recherches sur l'histophysiologie génitale chez les mammifères. Il fait aussi des études cytologiques sur la conjugaison des chromosomes, sur certaines doubles spermatogenèses, et sur la signification de ces dernières dans la détermination du sexe.

M. Max Aron, chargé de cours, suit l'histogenèse des îlots endocrines du pancréas chez les divers vertébrés et montre que le premier établissement de la fonction glycogénique coincide avec l'apparition des îlots définitifs; il étudie aussi le conditionnement de la régulation glycémique chez le foetus et cherche à montrer que les facteurs qui déterminent la fonction glycogénique et la régulation glycémique sont indépendants. Il poursuit ses observations sur l'hématopoïèse chez l'embryon, notamment dans le foie embryonnaire, les facteurs d'accroissement des os longs, le déterminisme des caractères sexuels secondaires chez les batraciens urodèles et anoures.

M. Benoît, premier préparateur, fait des recherches sur le déterminisme des caractères sexuels secondaires chez les oiseaux, sur l'hermaphrodisme expérimental et sur la transformation expérimentale du sexe chez les gallinacés. Il fait en outre des études sur l'histophysiologie des gamètes mâles, sur le rôle de l'épydidyme à ce point de vue, sur l'affinité sexuelle des gamètes chez les mammifères et chez les invertébrés hermaphrodites.

M. Courrier, deuxième préparateur, étudie le phénomène de l'activation de l'œuf fécondé et la signification de l'expulsion du liquide ovulaire ou "réaction épuratrice" après la fécondation. Il observe aussi la détermination saisonnière des caractères sexuels secondaires chez les mammifères dont l'activité génitale est cyclique, le conditionnement des phénomènes du rut, le rôle du follicule mûr chez les femelles de mammifères. Il continue ses recherches sur le déterminisme des caractères sexuels chez les poissons.

M. Spack, premier moniteur, fait des expé-

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riences sur l'influence des diverses radiations du spectre lumineux sur la croissance, et en particulier sur la division cellulaire chez les végétaux et chez les organismes inférieurs.

M. Alfonsi, deuxième moniteur, étudie l'action de l'injection de liquide folliculaire sur la structure de l'utérus et de l'oviducte dans certaines conditions physiologiques.

M. Reiss, assistant libre, poursuit des investigations sur le déterminisme des caractères sexuels chez les reptiles et sur l'évolution cyclique de la glande sexuelle chez ces animaux. Il étudie aussi l'action d'agents excitants sur le processus normal de la division cellulaire.

M. Gerlinger, assistant libre, fait des recherches sur le rythme génital chez la chienne et la chatte, sur la signification de la sécrétion de l'oviducte et des glandes utérines pendant le rut; il analyse le rôle du corps jaune sur les phénomènes préparatoires de la muqueuse utérine à la nidation de l'œuf.

M. Dreyfuss, assistant libre, fait des expériences sur la durée d'action du corps jaune sur la grossesse chez les mammifères dont les œufs sont à implantation pariétale.

M. Tsu-Zong-Yung, assistant libre, étudie le cycle oestrien vaginal chez la lapine et son déterminisme.

M. Brenkmann, assistant libre, poursuit des recherches sur l'activation dite traumatique de l'œuf mûr des batraciens, et sur les réactions histologiques qui se produisent dans les organismes soumis aux différentes avitaminoses.

M. Feuerbach, assistant libre, étudie la cryptorchidie expérimentale chez les mammifères jeunes et adultes.

M. Potvin, assistant libre, a commencé des recherches sur la greffe d'organes, et en particulier de glandes génitales.

COMPOSITION DU PERSONNEL ET TRAITEMENT

Le personnel de l'Institut d'histologie comprend:

Un professeur titulaire; un chargé de cours; deux préparateurs; deux moniteurs (étudiants); un technicien; deux garçons, dont un pour le service général, et un pour le soin des animaux.

En outre plusieurs travailleurs bénévoles (7) font des études spéciales dans le laboratoire. Le personnel officiel donne tout son temps à l'enseignement et à la recherche; personne ne pratique et n'a l'intention de pratiquer la médecine. C'est une condition formelle pour entrer dans le personnel enseignant de mon laboratoire.

Le salaire et les fonds affectés à mon service sont les suivants:

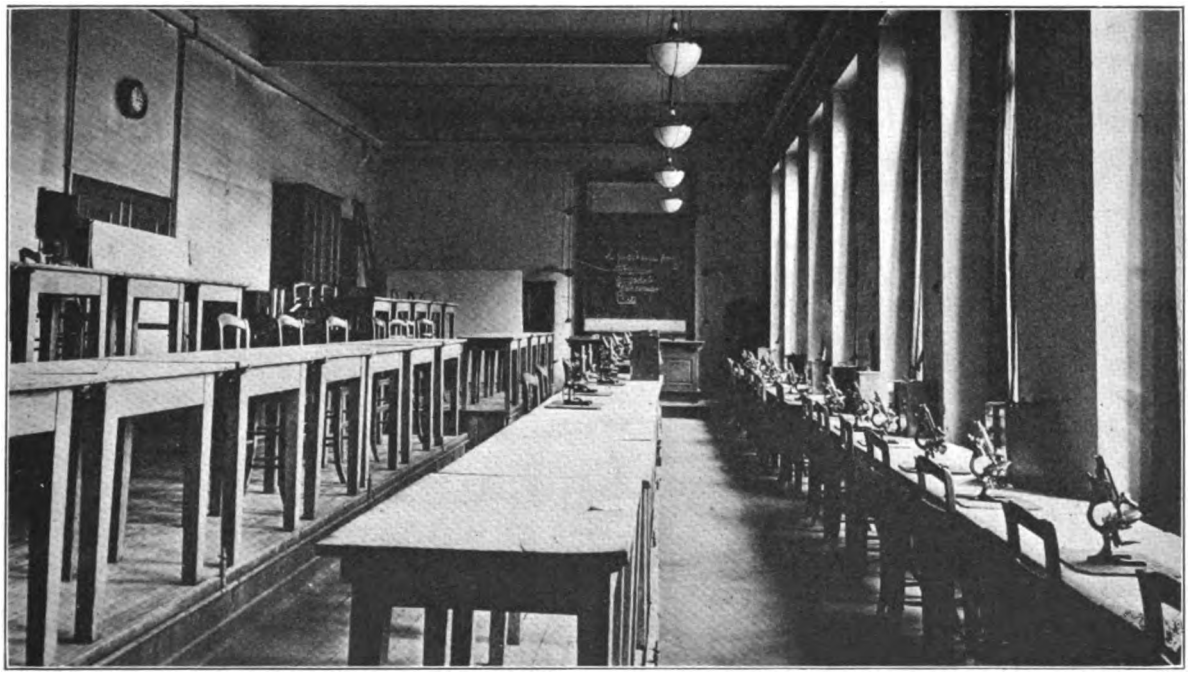

FIG. 3.—SALLE DE TRAVAUX PRATIQUES EN HISTOLOGIE

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	Traitement Francs	*Peréquation Francs*
Traitement du personnel enseignant[1]		
Professeur (1ère classe)	22.000	3.000
Chargé de cours (3ème classe)	12.000	3.000
Préparateurs	6.000	4.000
Moniteurs	2.000	
Traitement du personnel subalterne:		
Technicien	3.800	
Garçons	3.800	
Fonds affectés aux dépenses nécessitées par l'enseignement et les recherches	8.000	

Cette somme est évidemment tout à fait insuffisante. Beaucoup d'études scientifiques nous sont interdites à cause de cette pénurie de ressources.

[1] Il n'est pas tenu compte ici des indemnités spéciales qui ont été consenties aux universitaires d'Alsace et Lorraine, venus au moment et pendant l'année qui a suivi l'armistice. Elles ne sont plus accordées aux nouveaux fonctionnaires et on parle de les supprimer aux anciens.

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PATHOLOGICAL INSTITUTE OF McGILL UNIVERSITY

BY

HORST OERTEL, DIRECTOR

STRATHCONA PROFESSOR OF PATHOLOGY

HISTORICAL INTRODUCTION

The creation of pathological institutes which, while enjoying the double advantage of academic (university) and practical (hospital) connections, are nevertheless independent entities for the investigation and teaching of the science of disease, is, on the North American Continent, of very recent date. Two reasons, now antiquated, have retarded their development: first, the idea that pathology in a hospital is essentially the handmaiden of the wards and of the operating room for purposes of diagnosis and treatment of patients; second, that the medical school with its laboratories and staffs is theoretical and educational and, as such, distinct and separate from the concrete, practical hospital demands. Based on this distinction, a strict division between hospital laboratories and hospital duties of pathologists, and medical school laboratories and the school duties of pathologists arose at an early date, and continued into the twentieth century. It tremendously retarded and interfered with scientific education and the progress of medicine in America. It created an artificial distinction which in reality does not exist and cannot be carried out without thoroughly bad consequences. It made well-balanced training of pathologists and clinicians almost impossible, and had a deplorable effect even on the pathological education of the general practitioner, for it made the acquisition of fundamental knowledge, more especially in pathological anatomy and histology, so difficult that it was neglected or only superficially performed. It prevented academic and hospital pathologists alike from doing their full duty towards their science and students, and the contrast between the academic and clinical sides was accentuated to an alarming extent. It created that curious hybrid known as "clinical pathologist," who was neither clinician nor pathologist.

The new Pathological Institute of McGill University owes its origin to the desire to break away entirely from the difficulties which result from such a dualistic system, to bring the academic and practical sides of pathology into closest amalgamation, and particularly to combine the scattered resources of both into an entity for purposes of higher learning and practical application. To accomplish these ends the University and the Royal Victoria Hospital joined hands and resources.

McGill had early received a strong impetus and tradition in this direction. In the seventies of the last century Sir William Osler returned to Montreal from a study trip abroad full of enthusiasm and inspiration from Virchow in Berlin, and to Osler belongs the credit for having laid the corner-stone of scientific pathology at McGill. Recognition must also be made of the serious spirit of those early members of the Medical Faculty and of the contemporaries of Osler, whose Scotch descent and Scotch education and traditions brought them immediately into harmony with Osler's ideas and Virchow's teaching methods. It is therefore interesting to record here that McGill, of all American universities, had the earliest, most direct and lasting connections with the founder of modern pathology, for the present holder of the chair has also been largely guided by Virchow's influence.

For local reasons progress in pathology was somewhat impeded, but never interrupted, and incumbents of the chair of pathology at McGill had a firmer ground to build on than many of their colleagues in other universities on the North American Continent. The influence of Adami, the first professor of pathology, increased its prestige.

When plans for the building first took shape, it was decided to locate it on University ground, but in close proximity to the Royal Victoria Hospital, and to connect the two with a tunnel. The institute thus serves as a hospital morgue and hospital pathological laboratory, and at the same

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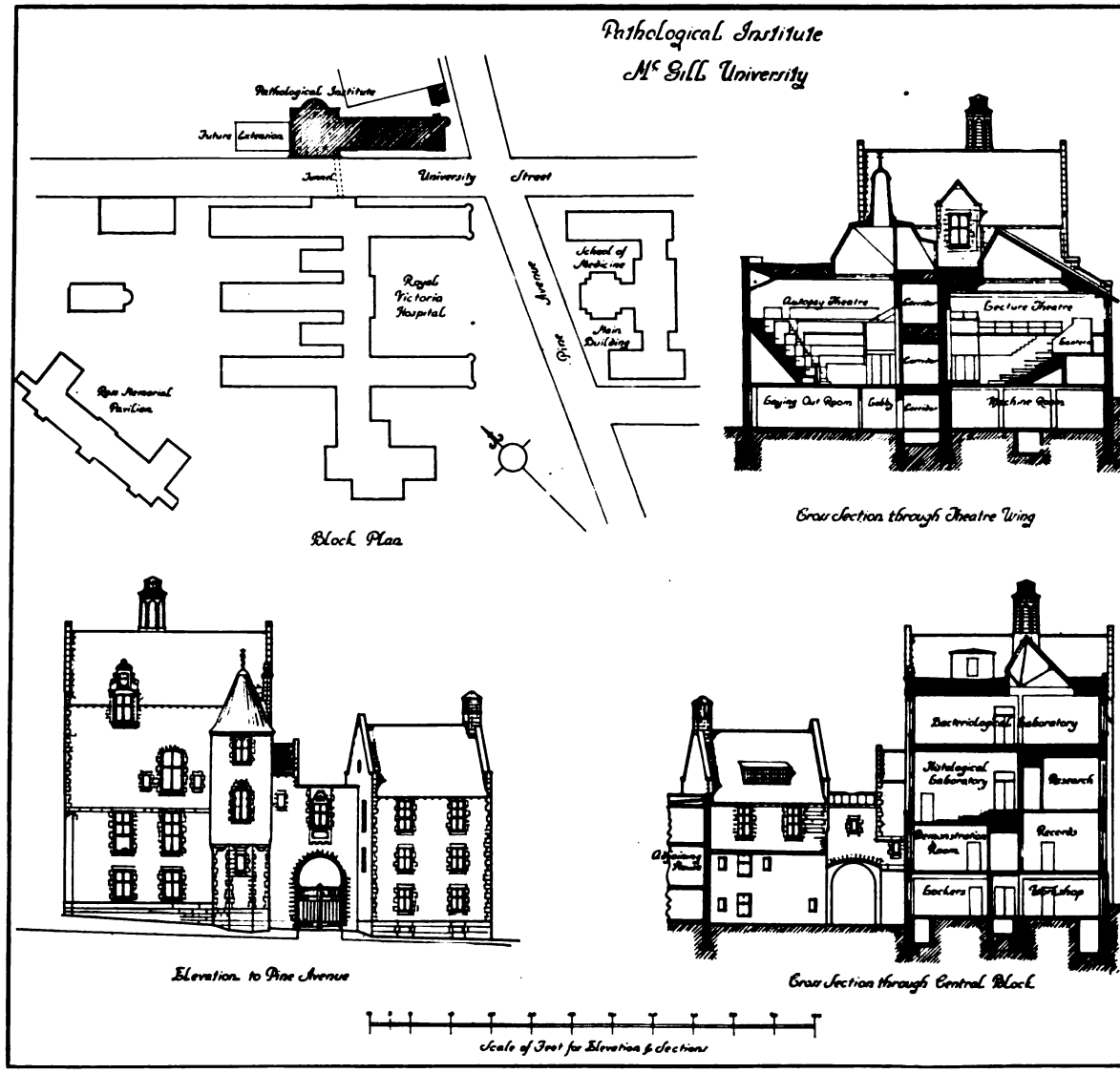

FIG. 1

time as an academic institute. The routine ward laboratories and the metabolism and clinical research laboratories are not included under the Department of Pathology, but under the Department of Medicine, and special provisions are made for them in the Hospital.

A few words as regards bacteriology and medical jurisprudence must be added. The position of bacteriology at McGill is peculiar. There does not exist, at present, an independent chair and Department of Bacteriology, but nominally this is still part of the title of the chair of pathology, and is represented by an assistant professor. The arrangement has certain advantages, within limitations, but bacteriology is also taught in the Department of Hygiene, in the Department of Botany, and by the School of Agriculture. These three departments, however, treat bacteriology from very different standpoints. Under the chair of pathology, bacteriology is presented entirely from the etiological, pathogenic, and immunity sides. It was decided to continue and even enlarge this division, and to include it in the new Pathological Institute.

It had long been the effort of the representative of medical jurisprudence at McGill to strengthen its position, to widen its scope, and to secure definite quarters for its prosecution and teaching

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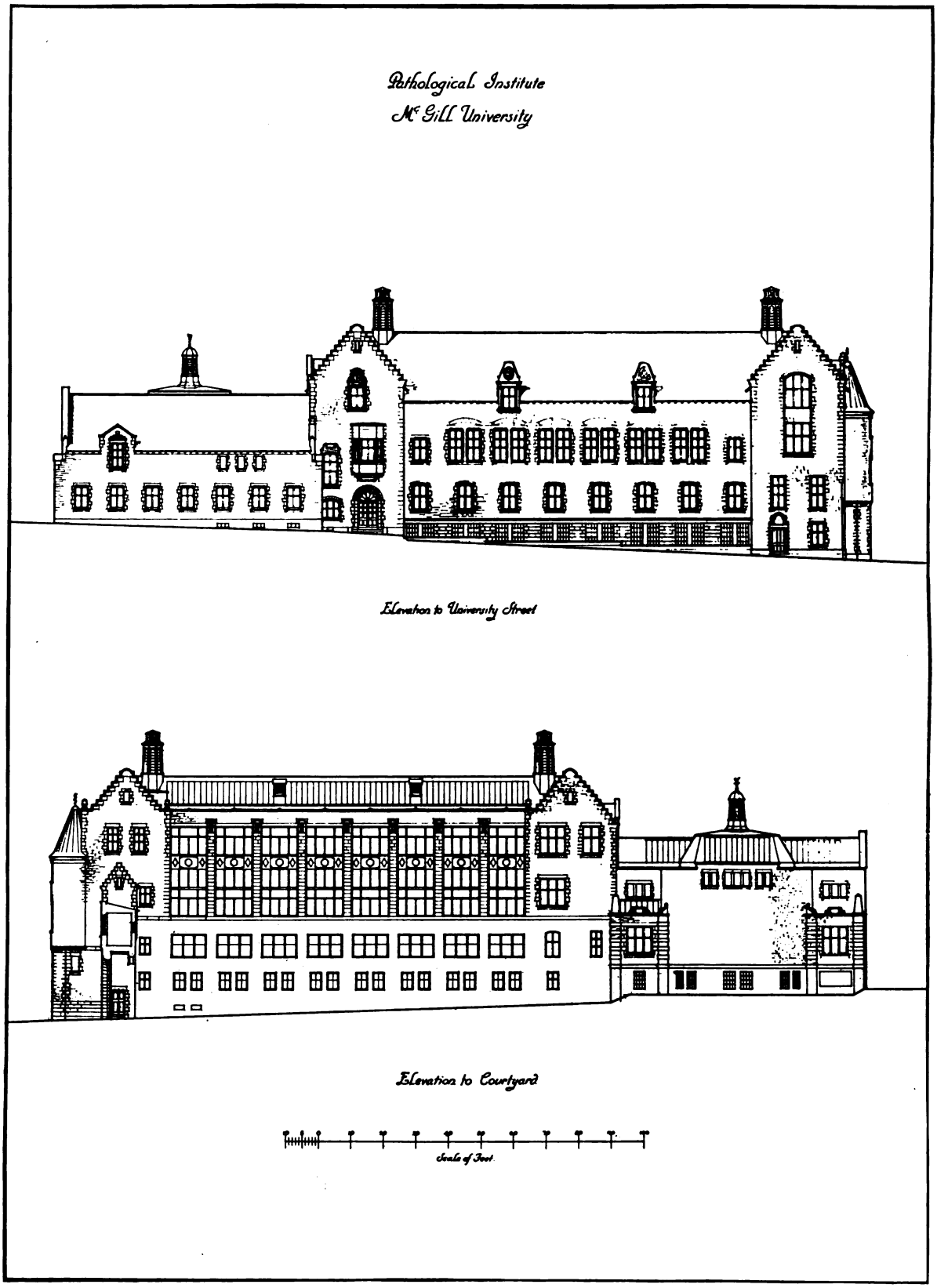

FIG. 2

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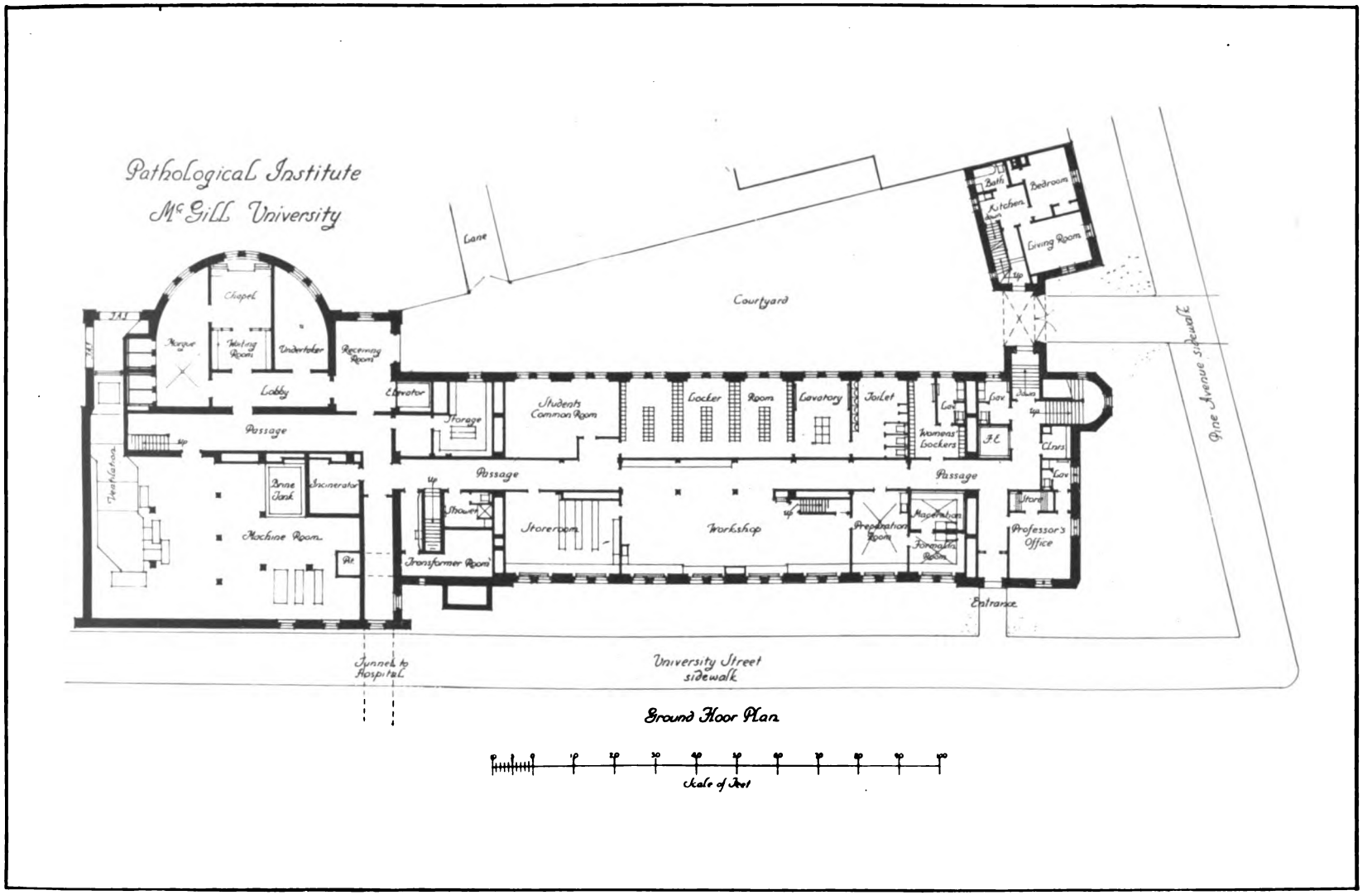

FIG. 3

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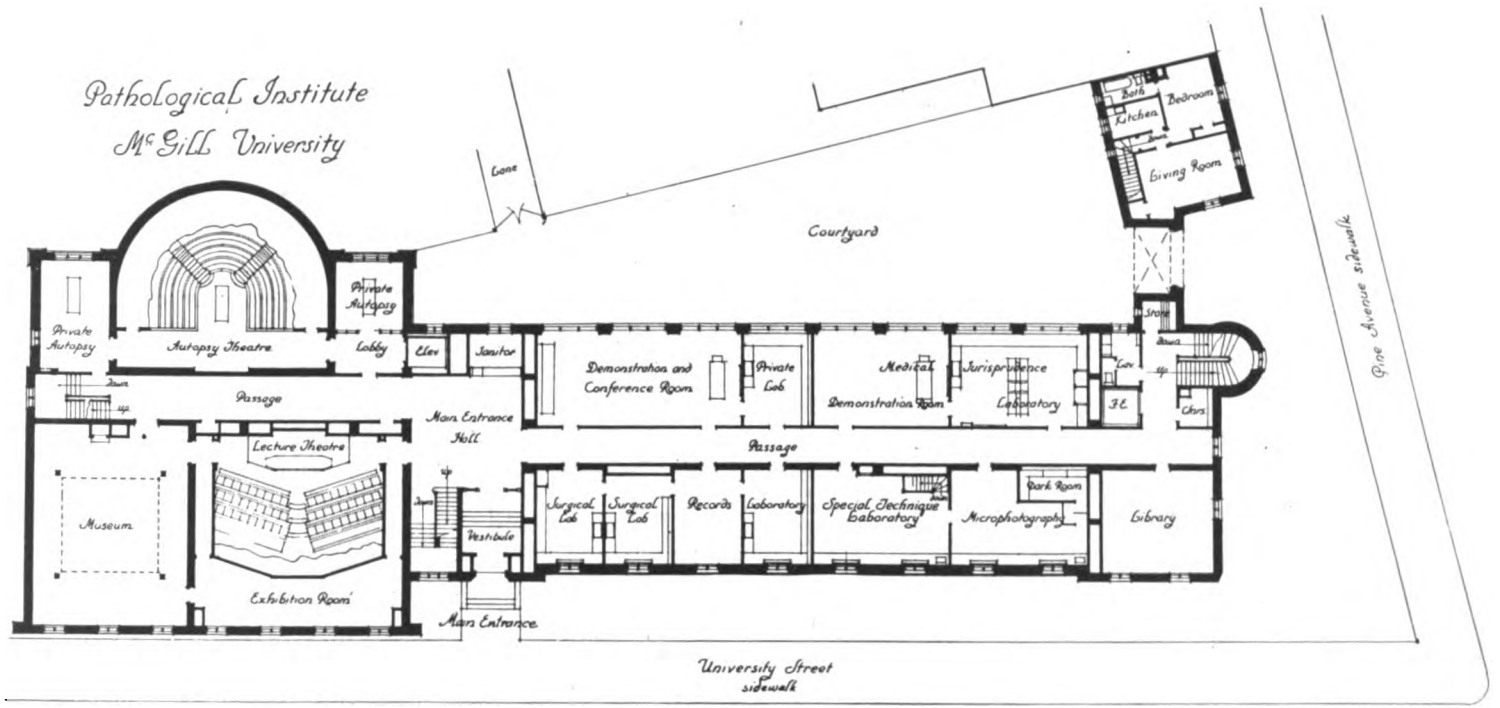

First Floor Plan.

Scale of Feet

FIG. 4

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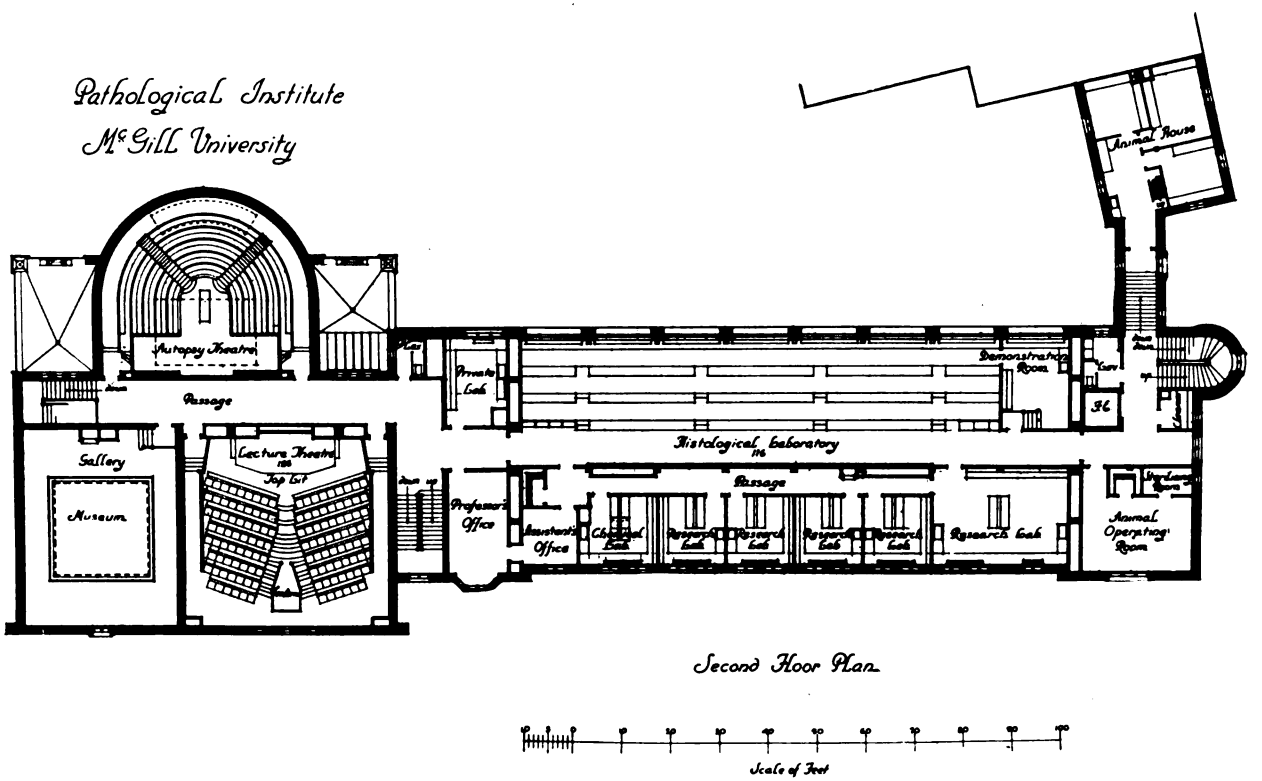

FIG. 5

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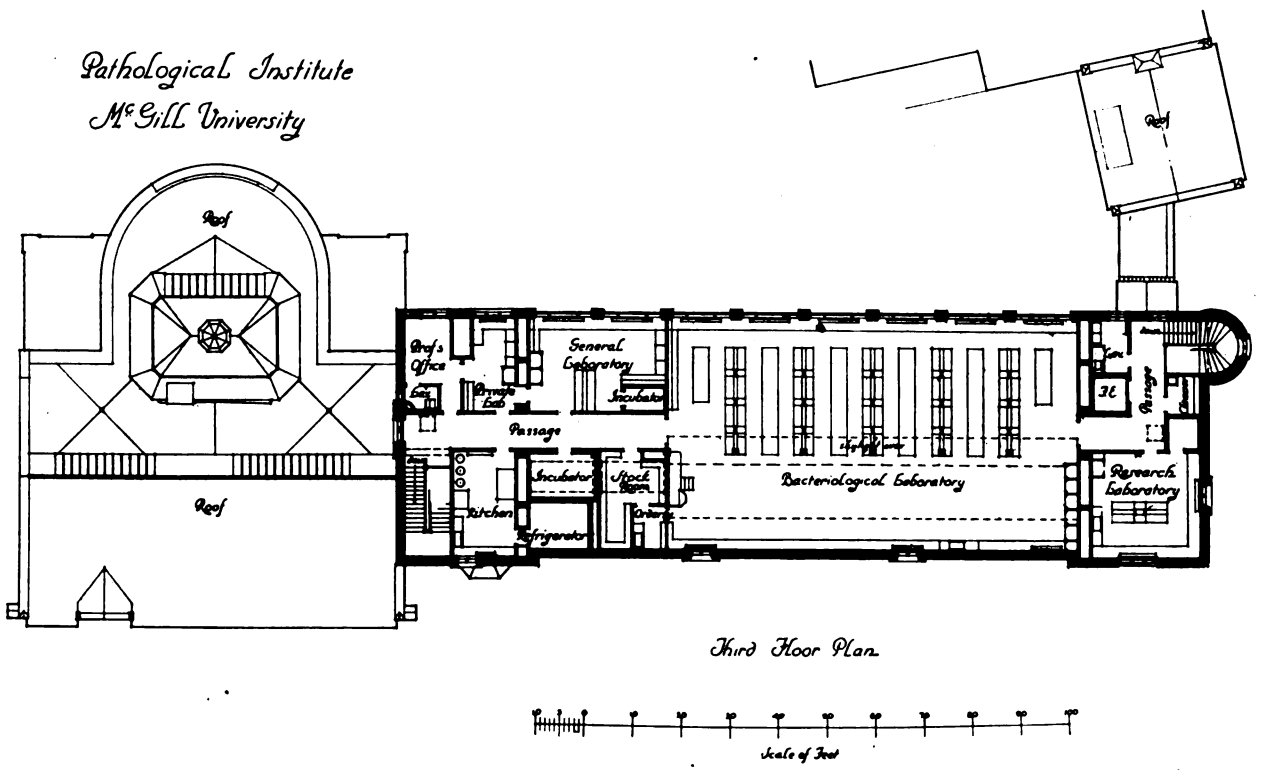

FIG. 6

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in the University. This desire was shared by the professor of pathology. Legal medicine has never received the recognition it deserves on this side of the Atlantic. Thorough practical training of medical men to perform legal autopsies and properly to interpret medical findings from the legal standpoint hardly exists in American universities, and it is a universal experience that only too often the ends of justice are defeated by a deplorable lack of education of medical men in the technique and interpretation of legal autopsies and other pathological knowledge. One or two recent experiences in Canada impressed this point very strongly on the authorities of the University. The intimate contact of legal medicine with pathology and bacteriology, upon which it really depends, and with which it constantly interacts, made it desirable to meet the demands of this Department in the new Institute. Consequently it was incorporated.

THE BUILDING

General Description

Guided by the principles outlined above, the building includes accommodations for the departments of pathology, bacteriology, and medical jurisprudence.

It is situated on the northeast corner of upper University Street and Pine Avenue (See Fig. 1). The main front (242 feet) and entrance faces west and is opposite the Royal Victoria Hospital. The other front, with an attached cottage containing attendants' quarters and accommodation for animals, faces south, that is, on Pine Avenue. The courtyard opens towards the Stadium and Fletcher's Field. The northern end of the building is 77 feet wide, and the southern part 60 feet.

The building is of Montreal stone, to harmonize with the other University and Hospital buildings. The architects have solved the difficult problem of combining laboratory efficiency with effective appearance. The lighting of the rooms in particular is excellent as the larger part of the wall space is given over to windows.

The following conduits are provided throughout the building: electric light, gas, hot and cold water, and compressed air. A number of rooms have, in addition, refrigerating pipes, live steam, and exhausts. Steam heat is furnished by the Royal Victoria Hospital. The laboratory floors are covered with linoleum, all sinks are of the standard alberene type. All laboratory rooms, as well as the auditorium, are provided with fume closets or hoods.

Ground Floor

The basement or ground floor of the building has its own street entrance at the southwest corner and at the north end is connected by tunnel with the Royal Victoria Hospital. At the northwest corner is a machine room with electric equipments, cold storage, and compressed air and ventilating systems. Across the passage is a morgue with accommodations for the storage of eight bodies, a small chapel, a waiting room, and an undertaker's room with receiving room, which are approached from the courtyard of the building through the covered archway facing Pine Avenue. A hydraulic elevator leads to the autopsy rooms on the first floor. The central part of the floor is largely taken up by storerooms, workshops, museum preparation rooms, toilets, a shower-bath, and a small lounge for students. The southwest corner forms the office and study for the professor of medical jurisprudence.

First Floor

The main entrance hall opens to the left directly into the large lecture room and museum, and into the autopsy suite consisting of a large theater and two smaller private autopsy rooms.

The lecture room is in the form of an amphitheater provided with a top gallery and from 130 to 150 seats, concentrated as much as possible around the lecture platform. The room is lined by acoustic tiles which prevent echo or reverberation of sound. Daylight is furnished by skylight principally, and artificial light by twelve high-power incandescent lamps. A large Zeiss epidiascope and projection apparatus of latest design and an automatic dark screen adjustment worked by a button from the lecture table complete the equipment. The lecture room opens directly into the museum which provides accommodation of exhibits on the floor and gallery, and is lighted by a northeast skylight. The walls being white, a very uniform and not too brilliant light is diffused throughout the room, even in corners and under the galleries, and direct sun reflection from the glass of the show-cases is avoided. Behind the lecture theater is a small exhibition room for specimens illustrative of topics of current lectures.

The autopsy rooms are in marble with high ceilings and special forced ventilation. The seats

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in the theater rise abruptly, affording a good view of demonstrations in the pit, even from the back benches. Attached to the ceiling is a special fixture, with seven 150-watt blue bulb lamps in focusing reflectors which concentrates artificial daylight on the operating tables.

To the right of the main entrance along a central corridor are two rooms for technicians, a record and a catalogue room, a laboratory for the assistant in charge of surgical pathology (examinations of tissues sent to the Institute from the Hospital and outside sources for pathological diagnosis), a room for special technique (such as the injection apparatus of Gross for the reconstruction of the circulatory arrangement of diseased organs, apparatus for stereoscopic exhibits, etc.), a room for the artist and microphotography, and, in the southwest corner, the departmental library and staff study. The latter is essential to staff and students for the use, while at work, of the principal reference works and of periodicals and books which on account of their specialized nature are not in the general medical library. It also stores duplicates of a number of journals which are always much in demand and thus can be made available for seminar and research work to several persons at once.

Opposite the library on the other side of the corridor are cleaners' closets, washrooms, and the large electric elevator. Then follow a large laboratory for the Department of Medical Jurisprudence, a demonstration room, a small laboratory for the junior staff in pathology, and, near the main entrance hall, a conference room for the pathological and clinical staffs where autopsied cases and surgical specimens from operations are jointly considered and discussed and demonstrated to students. The conference room contains a large exhibition refrigerator in which organs not intended for permanent museum preservation may be kept for days for inspection and reference without danger of decomposition.

FIG. 7.—PATHOLOGICAL INSTITUTE, MCGILL UNIVERSITY

SECOND FLOOR

On the second floor are located the study and the laboratory of the professor of pathology, and a large laboratory of pathological histology (112 ft. by 26 ft.) accommodating about 120 students. It faces northeast, the outside wall being entirely of glass. It is also illuminated by twenty-three 300-watt lights. The work-benches, which are provided with running water, basins,

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gas and electric light, rise in four tiers, each successive row looking over the one in front of it. Blackboards line the upper part of the back wall. A small space at the south end is partitioned off for the purpose of group demonstrations.

This floor has no general corridor, but a narrow passage extends along the back of the students' laboratory and gives access to five small research laboratories, one fitted up especially for work in microchemistry. The passage serves also as a storeroom for apparatus and supplies for the research laboratories. At its south end it leads into a larger research laboratory which opens into the general students' laboratory.

The room in the southwest corner is fitted up as an animal-operating room, and opposite it are cleaners' closets, washrooms, etc., and a passage which leads into the upper two floors of the attached cottage, where small animals are kept. The two lower floors of the cottage provide living quarters for the janitor and his family and for some of the technical helpers.

Third Floor

The top floor of the building is given over entirely to bacteriology and immunology. It comprises the laboratories of the professor of bacteriology and his staff; a large, fully equipped students' laboratory which is lighted from the northeast and by skylights; a media room; refrigerating and incubating rooms; and, at the southwest corner, a large research room.

It was not possible, largely for financial reasons, to provide in the present building more extensive laboratory accommodations for pathological chemistry and experimental pathology. But the building is so constructed that a wing for additional laboratories and additions to the museum can readily be erected along the north wall which is at present only a temporary, unfinished structure.

Costs

The costs of the building, exclusive of fees and interest charges, are worked out by the architects as follows:

Construction	$300,000
Engineering	102,000
Equipment[1]	60,000
Total	$462,000

[1] The expenditure on new equipment was $49,000; equipment with an estimated value of $11,000 was provided from existing buildings.

The cost per cubic foot[2] works out as follows:

Construction	37.3 cents
Engineering	12.7 "
Total	50.0 cents

The equipment cost is seven cents and a half per cubic foot of the building.

MECHANICAL EQUIPMENT

General

Steam for the heating system, domestic hot-water system, ventilating system, sterilizers, etc., is obtained from the boiler plant of the Royal Victoria Hospital. A high-pressure steam main runs from the Hospital through the tunnel under the street and then connects to the various systems through reducing valves. A high-pressure line is continued through the building, then underground in a conduit to the Field House at the McGill Stadium. A meter installed in the high-pressure line in the Hospital measures all the steam used by the Pathological Building and Field House. The condensed steam from these two buildings enters a pump and receiver outfit located in the pipe tunnel and is pumped back to the Hospital.

Most of the mechanical apparatus, such as circulating pumps, heaters, air compressor, ventilating supply fans, refrigeration compressor, brine pumps, etc., are located in the machinery room.

Heating System

The building is heated by means of forced hot water passing through radiators, except that the skylights have coils with steam passing through them. The water is heated by means of two converters located in the machinery room and is forced through the system by a centrifugal pump placed near the converters. There are two pumps so that in case it is necessary to shut one down for repairs the other can be operated. The water is heated by means of brass coils in the converters, which receive steam from the high-pressure line. Before the steam enters the converters, however, it is reduced to 15 lbs. pressure by means of a reducing valve.

[2] The cubic contents of the building are as follows:

	Cubic Ft.	Per Cent
Effective contents	444,000	55.2
Passages and stairs	91,000	11.3
Engineering, machine rooms, etc.	21,000	2.5
Walls, floors, ducts, and roof space	248,000	31.0
Total	804,000	100.0

The machine room accommodation is small, as the steam and power are provided from a central station.

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The steam for the skylight coils is taken from the same line that feeds the ventilating heating units and the return from the coils enters the condensation line from the heating units and then goes into the receiver and is pumped back to the Hospital along with the condensation from the other apparatus.

The temperature of the water in the heating system is controlled by means of a thermostat attached to the converter which acts on a diaphragm valve on the steam supply. The thermostat can be adjusted according to the outside weather conditions.

To prevent cold air from coming down from the top parts of the high windows in the Histological Laboratory and striking the students at work on the benches in front of the windows, it was necessary to enclose the radiators in front of the windows in a special way. Plate glass baffles were extended up about four feet above the benches and kept about six inches from the windows. The enclosures were arranged in such a way that the radiators sucked the cold air down from the windows into the space between the plate-glass baffles and the windows.

Ventilating System

The ventilating system was designed so as to give as perfect and complete ventilation as is possible. It was also designed so that as much of the air as possible could be recirculated if desired; that is, instead of the exhausted air being sent outboard, it is returned to the supply fan (after being properly treated) and is used over again. It was not deemed advisable to recirculate the air from certain of the rooms, due to the nature of the work carried on in them, and the exhaust air from these rooms is sent outboard. About 60 per cent of the air supplied to the building can be recirculated or used over again. The recirculation of that amount of air represents a great saving, for it is returned to the supply fan at 68° to 70° instead of from 32° to 20° below zero. This means a saving of approximately one hundred tons of coal a season. Before the air is used over again, however, it is deodorized by an ozone apparatus and cleaned by an air washer.

There is a total of seven fans—three supply fans and four exhaust fans. The three supply fans are located in the machinery room; one supplies air to the lecture theater, one to the autopsy theater and private autopsy rooms, and the third, which is a large one, to the remainder of the building. It was deemed advisable to have separate fans for the lecture theater and autopsy theater as these rooms might be in use when the rest of the building was not. The four exhaust fans are located as follows: The main exhaust and recirculating fan and the lecture theater and recirculating fan in the north gable, the exhaust fan in the south gable, and the autopsy theater exhaust fan in a fan house above the autopsy theater. The lecture theater exhaust air can be recirculated if desired, but the exhaust air from the autopsy theater cannot.

The fresh air comes in through a tunnel into the mixing chamber where it meets and mingles with air from the recirculating tunnel, and then passes into the air-washer and humidifier and through heaters where it is heated to the proper temperature and then enters the three supply fans and is sent to different parts of the building. The supply fans are separately controlled so that each of them can be run separately.

The main exhaust and recirculating fan in the north gable exhausts the air that can be recirculated, and sends it into a deflecting box. This box is so arranged with two damper louvers that the air can either be sent outboard through the roof or else down through the recirculating shaft. When the outboard damper louver is open the other is shut, and vice versa. The dampers are pneumatically controlled by means of switches in the machinery room. The deflecting box contains the ozone apparatus through which all the air must pass to be sterilized and deodorized before entering the recirculating shaft. From the recirculating shaft the air passes down through the building to the basement where it enters the mixing chamber and mingles with the fresh air from the outside and then enters the air washer and repeats the cycle. The amount of fresh air from outside is regulated by means of a damper louver in the fresh-air tunnel, pneumatically controlled from the switchboard. The air can be either recirculated or not, at will, by means of the two switches. It is necessary, however, in recirculating to leave the fresh-air damper open sufficiently wide to let in about 40 per cent of the required air.

A fan in the south gable exhausts and expels all the air that it was not deemed desirable to recirculate, including also air in rooms that it was not convenient to connect to the recirculating system. The lecture theater exhaust fan, located in the north gable, has a deflecting box and dampers, etc., arranged in a similar manner to the main recirculating fan. When air from this fan is not being sent outboard it enters the

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same recirculating shaft as the other fan. The temperature of the air for the supply fans is automatically controlled by means of a thermostat located in the air housing, which controls valves on the heating stacks.

The proper humidity is secured by a device used in connection with the air-washer and is controlled by a thermostat which operates a diaphragm valve on a steam line leading to the humidity device and governs the temperature of saturation. The temperature control, humidity control, and pneumatic dampers operate by means of compressed air which originates from a small electric air compressor cross connected to the large compressor so that either can be used.

All ventilating fans are run by means of direct-current electric motors belted to them and controlled individually from the machinery room. Small fans on the top of the fume closets exhaust the fumes into tile ducts which run up through the building and the roof. There are nine such fans in all, varying in size according to the number of closets to be taken care of. Six fans take care of six individual closets, two fans of two sets of two closets each, and one fan of a set of four closets.

Plumbing System

The plumbing system consists of the drainage from the building of all foul water, sewage, etc., and a complete system of venting all fixtures, a cold-water supply from the street to all the fixtures, a hot-water supply to the fixtures requiring it, a fire-line system, a gas supply to the laboratory tables, incinerator, etc., a compressed-air system, etc.

There is a total of fifty-six domestic fixtures which include the usual lavatories, water closets, slop sinks, showers, urinals, etc., located in different parts of the building. The special equipment fixtures are described later.

A 4-inch high-pressure water-main enters the machinery room from University Street and after passing through a reducing valve branches off to the various fixtures and fire-lines. Most of the cold-water mains run in the tunnel under the ground floor. Another 4-inch cold-water connection is made in the southwest corner of the building from the Pine Avenue water-main to the water piping in the tunnel. This is an emergency connection, to be used in case the other connection fails.

The hot water for domestic use is furnished by a heater located alongside the converters in the machinery room. Steam for the hot-water heater is taken from the same branch that feeds the converters. The condensation goes back to the return pump and receiver after passing through a steam trap. The temperature is regulated by means of a thermostat located in the hot-water tank which controls a diaphragm valve on the steam line. The feed to the hot-water tank is connected to a waste-water tank in the north gable which receives its water at a temperature of about 85° F. from the condenser of the refrigeration plant. This saves the condenser water that would otherwise be thrown away, and also saves coal as the temperature of the water is 85° F., whereas water from the city mains in the winter time is around 50° F. or lower.

Various fire-line risers are taken from a 3-inch fire main located in the tunnel, and hose racks and fire hose are attached to them at various outlets.

A 3-inch gas main enters the building from the University Street side and after passing through a meter connects with the incinerator, laboratory tables, students' tables, fume closets, kitchen, incubator room, lecture theater, autopsy theater, etc.

The compressed-air system consists of an air compressor outfit and receiving tank situated in the machinery room. The compressor is operated by means of a belted electric motor and has an automatic starter and stop controller. As soon as the pressure in the tank reaches a certain point the motor stops but starts again when the pressure is lowered. A 2-inch compressed air main runs from the air receiver through the tunnel and connects with the compressed air risers in the various rooms.

Special Fixtures

The special fixtures include the acid-resisting sinks, wash-up sinks, utility sinks, general sinks, laboratory sinks, stain sinks, animal cage baths, autopsy tables, etc.

There are twenty-six acid-resisting alberene sinks in the various laboratories and other rooms, all having alberene drain boards equipped with three to four quarter-inch water connections. The sink in the workshop on the ground floor has on each side an alberene drainboard ten feet long. The sinks have both hot- and cold-water supplies and are provided with acid-resisting lead traps and acid-resisting standing waste and overflow.

Three special wash-up sinks in the private autopsy room, autopsy theater, and animal-

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FIG. 8.—CLASS IN PATHOLOGICAL HISTOLOGY

operating room are of vitreous china and have elbow action combination hot- and cold-water supply valves. Eight laboratory sinks fitted into the tables or benches in various rooms have gooseneck hot- and cold-water supplies. Thirty-eight stain sinks 11 inches long by 11 inches wide by 8 inches deep in the benches or tables in the bacteriological students' laboratory, the research laboratories, and various other rooms are made of vitreous china, and have a gooseneck cold-water supply.

The animal house has two animal cage baths large enough to receive the animal cages and thoroughly clean them. On the outlet of each is a large cast-iron trap to catch all the refuse, etc., from the cages.

The private autopsy room has a solid porcelain autopsy table 6 feet 6 inches long by 2 feet 6 inches wide supported by porcelain pedestals, and provided with a special mixing valve to supply hot and cold water. There is a special autopsy table with revolving top in the autopsy theater.

In the tables in the histological laboratory are forty-four copper funnels 8 inches in diameter at the top, which act as stain sinks. Each funnel has a gooseneck cold-water supply and is connected to the waste lines. Each fume closet is also equipped with a copper funnel and cold-water supply.

Rim flushing floor drains are installed in each of the private autopsy rooms and in the autopsy theater. These are of the hospital type and have cold- and hot-water connections controlled by means of valves on the walls.

REFRIGERATION

The refrigeration plant consists of motor-driven ammonia compressor, ammonia condenser, brine tank, and brine circulating pumps, etc., located in the machinery room. The brine tank contains the expansion coils which are connected to the compressor and condenser and extract the heat from the brine in the tank. The brine is circulated from the tank to the various refrigerator boxes by means of a centrifugal pump directly connected to a motor. There is a duplicate pump outfit to be used in emergencies.

The size of the brine tank is such that it is necessary to operate the ammonia compressor only about six hours a day to provide sufficient cold brine. The brine is kept at about zero degrees Fahrenheit. Provision is also made in the brine tank for the manufacture of a small amount of ice when desired.

The pump circulates the brine to coils in the

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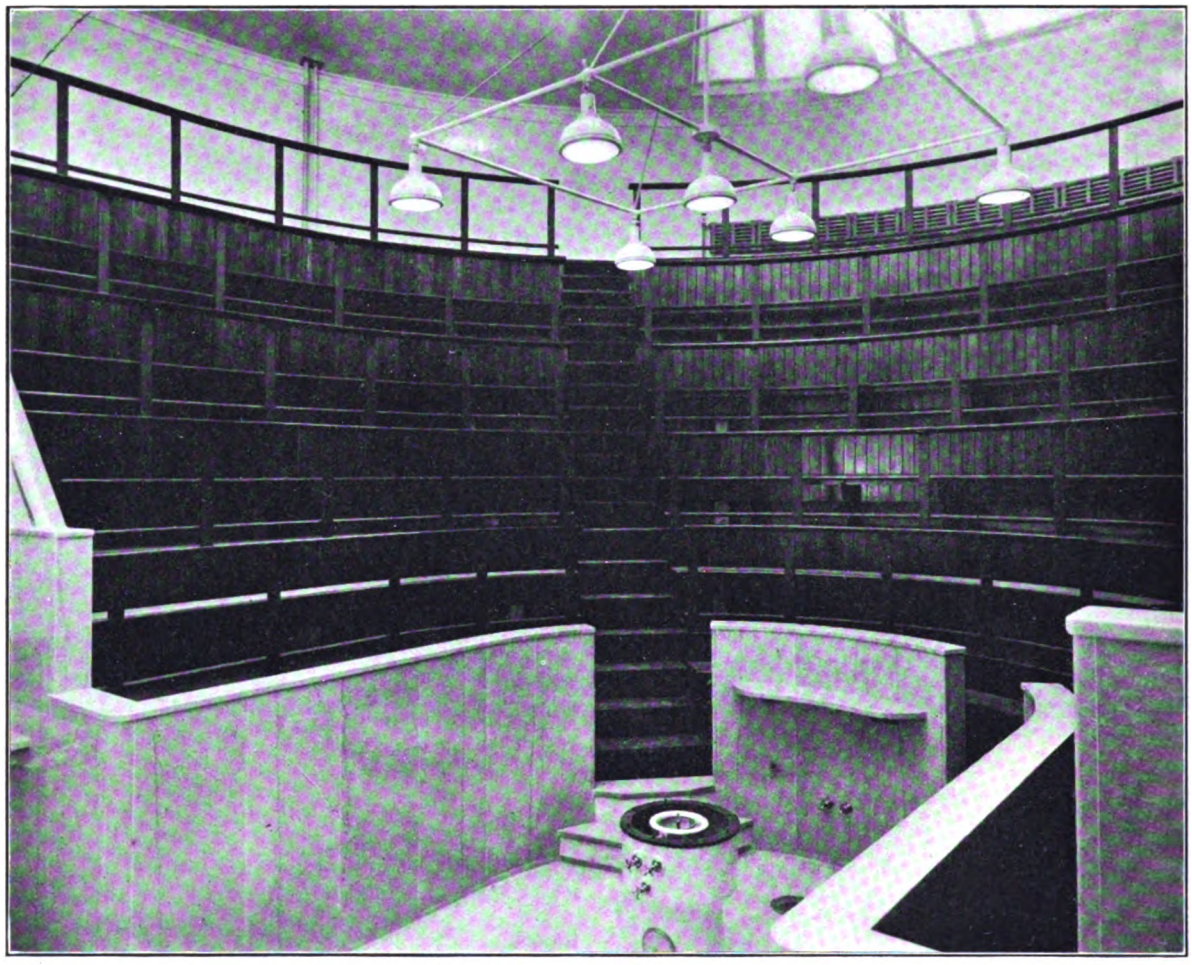

FIG. 9.—AUTOPSY THEATER SHOWING ARTIFICIAL DAYLIGHT CLUSTER OF LAMPS OVER THE OPERATING TABLE, OF WHICH THE BASE ONLY IS SHOWN

mortuary in the morgue, in the display refrigerator in the demonstration and conference room, and in the large refrigerating room on the second floor which is used in connection with the bacteriological laboratories and contains cultures, etc. The display refrigerator is of special construction to enable interesting specimens to be kept on view in a temperature below freezing.

Provision is made for the extension of the system should it be found necessary in the future.

ELECTRICAL EQUIPMENT

The electric power used in the building is supplied by the local power company through an underground service to the transformer room, at 2,200 volts, three-phase. Separate banks of transformers are provided for power and lighting. Three kinds of current are supplied, namely 220-110 volt three-wire alternating current for lighting, 220-volt three-phase alternating current, and 220-volt direct current for power. The latter is reduced for lantern use to 110 volts. The direct current is supplied by a motor-generator set of 25 KVA capacity which is run when required.

A central distribution switchboard for the control of all circuits is located in the machinery room and consists of black, marine finish, slate panels with the requisite switches on the front and all the connections at the back. The rear of the switchboard is closed off by a heavy wire grill and is not accessible to unauthorized persons. All local distribution panels throughout the building are of the "safety type."

Alternating current power is used for all electric motors not requiring special speed control, such as the hot-water circulating pumps for the heating system, the refrigeration machinery,

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brine pumps, and elevator. Numerous outlets are provided in the laboratories and workshops where they may be required for the connection of small motors.

Direct current power is used for driving the ventilating fans where variable speed is advantageous. Provision is also made to have direct current power available at different points throughout the laboratories. Direct current is supplied to the large projection lantern in the lecture theater.

The system of lighting adopted throughout is general illumination from ceiling outlets sufficient for the usual work of the locality, with a liberal supply of utility outlets on walls and work benches for the easy connection of lamps for special purposes or for apparatus requiring electric current. The overhead fixtures are of the totally enclosed type suspended from solid stems with a flexible link at the upper end. The diffusion of light is excellent and uniform over working spaces.

In the histological and bacteriological laboratories the general illumination was designed to supply an approximate approach to daylight so that better color discrimination could be obtained. This was done by the use of blue-bulb lamps, the average illumination on the working plane being about eight foot candles. In addition to the general illumination, plug receptacles are supplied on the work tables at each student's position for the attachment of local lighting fixtures, such as microscope lamps.

The autopsy theater is provided with sufficient illumination to permit the students to make notes, while over the autopsy table is hung a special fixture with seven 150-watt daylight lamps in concentrating projectors. These projectors have etched glass diffusing screens to eliminate glare and are adjustable so that the light can be concentrated on any part of the table. The whole fixture is hung high enough not to interfere with the vision of the students and also to prevent the heat of the lamps from bothering the operator. The same type of operating table fixture, but of smaller size, is supplied in the private autopsy rooms and in the animal operating room.

The blinds in the lecture theater are operated electrically by simply pressing a button under the lecturer's desk. This is a great convenience for darkening the room quickly when the projection lantern is to be used.

The large incubator room for use in connection with the bacteriological laboratory is electrically heated. Special arrangements have been made for securing even and uniform temperature. The walls are insulated by a number of thicknesses of insulating board with air spaces between them. The heaters are controlled by two thermostats at opposite ends of the room, though each heater is so switched that it can also be controlled by hand. Heaters are mounted on the wall behind a baffle partition on which the shelving is carried. This baffle serves the double purpose of shielding the contents of the room from direct radiation from the heaters, and also promotes the rapid and directed circulation of air necessary to insure a uniform temperature at all levels of the room.

TEACHING METHODS

Pathology

The methods of teaching pathology at McGill differ, in some respects, from those employed elsewhere. Pathology is primarily presented as a purely scientific and cultural subject without reference to its direct practical application. The course in general pathology is open, therefore, not only to medical students, but to students in all other faculties, in order to bring them into contact with the relations of the problems of disease to biology, philosophy, ethics, and law, and also to discuss their influence on the science of pathology. Here the student is introduced to the great questions of pathology in their philosophical aspects and to the position of pathology among the sciences. To this end the influence of philosophical thought and development, more especially of Kant, on pathological conceptions is traced; the standing of metaphysical interpretations and causal explanations in regard to pathological classifications is fully discussed; and the historic evolution of the conception of disease is thus developed.

These general prolegomena are followed by a consideration of the internal and external factors of disease, including their genetic relations as, for example, the problems of heredity and of embryogenesis; the general phenomena of infection and immunity in their chemicophysical aspects; the anatomic-histopathological changes and their development; and the biological foundations of somatic death. The student is therefore introduced to the science of pathology not as a fixed structure or as a premedical subject, but from the standpoint of historic and scientific orientation. In other words, he is taken to the threshold of the subject and prepared to enter it himself.

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This didactic course is accompanied during the second half of the session by practical laboratory instruction in pathological anatomy and histology. The student thus becomes acquainted with the methods of examination of diseased tissues, observes many fresh, unstained microscopic specimens, performs important microchemical reactions, and is taught how to visualize processes of disease. When possible, this is aided by experimental demonstrations.

In the subsequent lectures on special pathology, the more practical medical aspect of the subject is emphasized, and a detailed illustrated study of the important organs and systems of the body in their anatomical changes, development, and functional significance is prosecuted. This didactic course is very fully illustrated by projections, charts, and group demonstrations of gross and microscopic material. Emphasis is always laid on the anatomic-histological side in order to give the student a firm visual objective basis for his own later personal experiences and to enable him in the diagnosing of clinical cases to think in anatomical terms and possibilities, instead of in hazy symptomatic pictures.

For this purpose, also, anatomic diagnostic exercises are conducted in the theater with a twofold object: first, to acquaint the student with, and demonstrate to him, the importance of a systematic pathologic-anatomical technique, as required by clinical and medico-legal cases; and, secondly, to prepare him in the methods of anatomical diagnosis and interpretations of lesions in relation to the case as a whole. In this connection students are called to the pit, as in the clinical theater, and are expected to develop anatomical diagnoses in question and answer for the benefit of the whole class. These exercises are also freely attended by physicians.

During the last year, the students themselves take part in the performance of autopsies and are expected to witness particularly those cases which they have clinically observed.

The didactic course in special pathology is sup-

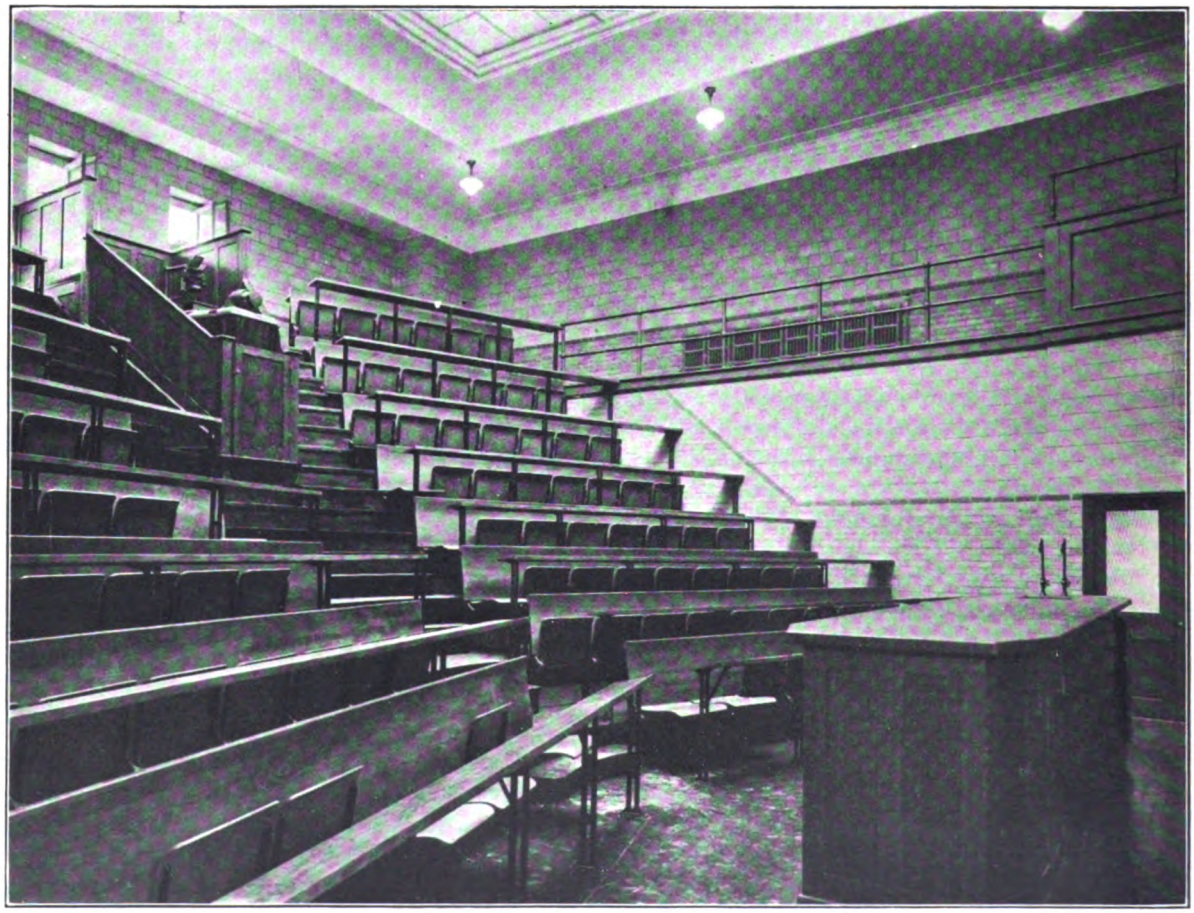

FIG. 10.—AUDITORIUM

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plemented by lectures and demonstrations on special subjects by members of the staff and by a practical laboratory course. Advanced autopsy instructions and pathological conferences are also conducted in the Montreal General Hospital as part of the pathology curriculum.

Throughout the courses in pathology, care is taken to unfold the great questions of the science, to direct the student's attack upon the problems of disease, and to train him in scientific interrogations rather than in details of fact.

Theoretical discussions pertaining to the more highly specialized branches of pathology, as immunity, for example, are reduced to the minimum in order to prevent the student from burdening his mind with uncertain, highly technical, hypothetical, constantly changing categories, the value of which he is often unable to judge, and which are only too liable to lead to misunderstandings. These are only indicated and left to later (graduate) study on maturer experience.

A certain amount of time, however, is given to seminar work and reading of the originals of classics in pathology. Textbooks and textbook memorizing are discouraged, and everything is done to prevent pathological knowledge from fossilizing in the student's mind, and to make him appreciate the fluid condition of the science and the necessity of keeping step with its progress and changes during later years. The examinations are also conducted from these standpoints.

In the laboratory exercises an abbreviated course in pathology adapted to their purposes is given to dental students by a scientific assistant of the pathological staff.

Bacteriology

It has already been stated that bacteriology as represented in the McGill Pathological Institute is devoted to teaching and enquiry along pathogenic and immunity lines. The course, which is under the immediate charge of Professor Bruère, is arranged in such a way as to place before the student (1) the general phenomena of bacterial, parasitic life; (2) the significance and importance of bacteria in relation to disease; and (3) the general methods of bacterial cultivation, isolation, and recognition. These are followed by (4) a consideration of the chief individual pathogenic forms.

The didactic lecture and demonstrative course in bacteriology is supplemented at the same time by laboratory instruction, to which each student devotes four hours a week during one term of thirteen weeks. In it students become acquainted with the principal fundamental bacteriological methods; they cultivate, isolate, and identify bacteria, and carry out the important bacteriological reactions. They also do the common simpler immunity reactions, such as agglutinations, etc.

Graduate courses concern themselves with advanced methods of bacteriological and immunity research and the application of these to the diagnosis and treatment of individual infectious diseases. A special course of twenty-five lectures and demonstrations treats of higher animal parasitism and its relations to disease (parasitology). This is conducted by Professor Todd.

Medical Jurisprudence

The instruction in medical jurisprudence, in charge of Professor MacTaggart, comes under two headings, namely the criminal and the civil aspects of the subject. In the first, consideration is given to the medico-legal objects, the observing of dead bodies, the performing of autopsies from the medico-legal standpoint, the recognition of criminal violence, the symptoms and post-mortem evidence of various poisons, and the microscopic and serological recognition of blood and other secretions and excretions, etc. The important questions of criminal responsibility and mental states, so frightfully abused in modern criminal practice, are included.

A considerable part of the time is, secondly, devoted to the civil side of medical jurisprudence, with particular reference to the legal aspects of insurance, compensation acts, and opinions on invalidity. Experimental and clinical demonstrations supplement the didactic instruction.

ROUTINE WORK OF THE INSTITUTE

At McGill, work in pathology is chiefly centered on the prosecution of pathological morphology.[1] Its basis is the autopsy, which is cultivated with care and supplemented by experiments. Material is derived from the Royal Victoria Hospital, the Foundling Hospital, the Maternity Hospital,

[1] Perhaps I should add here as a qualification, that I consider a thorough cultivation of pathological morphology, in all its aspects and bearings, indispensable not only for the physician, but for the pathological investigator. I deplore the modern tendency to divorce "experimental pathology" more and more from pathological morphology and autopsy experience, and to accord it a more or less independent and, as some believe, superior position to "dead house" experience.

But pathological anatomy, histology, and pathological histogenesis are even more essential to the understanding of pathological function than normal anatomy and histology are to normal physiology; and pathology is far from being "applied physiology." Experiment and conclusions may be quite valueless, even misleading, when they stand in disagreement with actual anatomic-histological circumstances of which the investigator has failed to fully inform himself.

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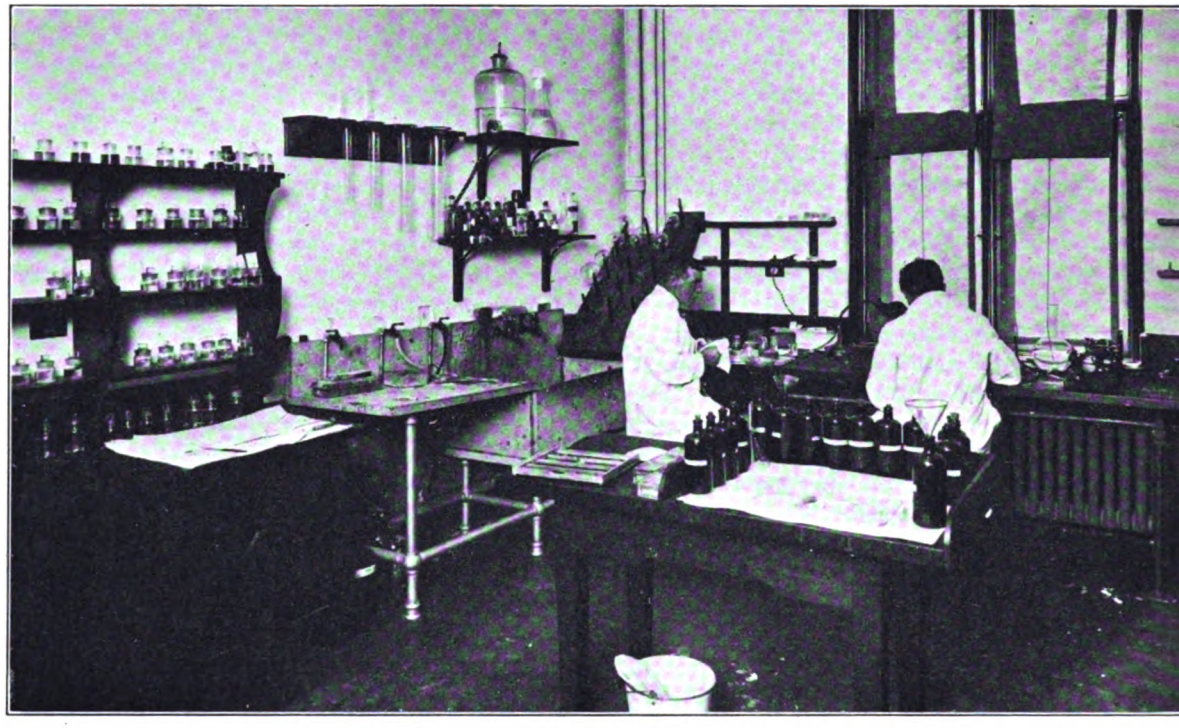

FIG. 11.—PRIVATE LABORATORY

the Verdun Hospital for the Insane, and the Alexandra Hospital for Contagious Diseases. Autopsies are conducted by members of the pathological staff, under the immediate control of the prosector, and subject to the supervision and direction of the professor of pathology. The fresh anatomical material is demonstrated by the autopsiest to the whole staff, when the case is discussed and questions for future investigation and report raised. The autopsiest then prepares a final protocol of the case, embodying also the microscopic and bacteriological findings and the important features of the case, and this is presented and fully discussed by all the members of the Institute staff at a subsequent meeting. A typewritten record of the case is ultimately filed, with a complete anatomical diagnosis, which is entered in a card catalogue. All anatomical diagnoses are held as objectively as possible, so that no matter what classification an investigator may employ he may be able to find and utilize the filed records. Where possible, charts and photographs of the "situs" and lesions are filed with the record. The anatomical diagnostic exercises on the dead body and with fresh material are conducted by the professor before the whole class, and he also presides over the staff conferences. Junior members of the staff have to train themselves thoroughly in anatomical and histological methods and diagnosis before they are encouraged to undertake original work. No one in the Institute is ever encouraged to specialize exclusively in one branch of pathological research to the exclusion of all routine. Everyone is expected to keep in touch with all the Institute work and avoid narrow specialization. Junior members also, under direction and with the assistance of a senior member, report on the surgical specimens sent in from hospitals and outside sources. These are presented and discussed at conferences to which the hospital staffs are invited.

In connection with the Institute routine, yearly reports and statistical statements are published.

SPECIAL LINES OF INVESTIGATION

Only a short outline of a few general problems are included here.

A considerable amount of work has already been done, or is in progress, on the investigation of architectural reconstruction of organs and tissue systems in different age periods, and in disease, in order to follow and compare normal and pathological structural arrangements. The technique employed is that which Gross several years ago worked out in these laboratories in funda-

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mental researches on the reconstruction of the circulatory tree.[1] This has broken new ground and has already yielded useful information as regards age period changes and pathological organ reconstruction in the heart, kidney, and liver. These studies have already appeared in print. Out of this work arose the conception of "morphological fluidity" under normal and abnormal conditions. It throws light on normal age period changes, age predisposition to disease, and the functional disturbances incident to pathological lesions. At present Dr. Wilkie is extending this field to the study of sexual glands. Closely associated with it have been investigations into normal and abnormal cell and tissue regression and progression in various organs, and their bearing on the development of organic lesions.

Another line of investigation recently undertaken by Dr. Wilkie is the study of the earliest local tissue responses to the presence of tumor cells with particular reference to the development of the blood vessels and the blood supply upon which the growth and organization of these cells to the cancerous tumor really depend.

A field of study, in charge of Dr. Waugh, is devoted to blood-forming organs and the ever-increasing importance of constitutional factors in the development of diseases of the blood. The first fruit of this study has been contributions on the origin and nature of Gaucher's disease, and on anemias, and observations are now in progress on the purposes and on the fundamental physical principles of thrombosis.

The Director of the Institute has lately been engaged in critical studies of the fundamental problems of cellular pathology in relation to organization and causal connections in the life of higher metazoa; he had, in addition, devoted attention to questions of pathological classifications and definitions. These are now being put in shape for monographic publication.

In the Department of Bacteriology and Immunology a beginning has been made in the application of recent advances in physical knowledge to the explanation of immunity reactions. Many of the older chemical explanations still to be found in textbooks have been discarded and are no longer included in bacteriological instruction. Immunity reactions are approached from physical, electric, and colloidal standpoints.

MUSEUM

The museum of the Pathological Institute is maintained essentially for the purpose of supplying a representative collection of pathological specimens for instruction and to preserve unusual lesions and other material for research. The incorporation of the pathological museum into the new institute has tremendously improved the quality of the preserved material. Lack of space, as well as of funds, forbid the development of a very large and varied collection. Museum specimens are used for the earlier part of instruction, as they are best suited to throw certain features of pathological processes into relief. For more advanced teaching fresh material is utilized whenever possible, and museum specimens are drawn on in order to illustrate diversity of lesions and differences in individual expression. The museum classification followed at present is also an extremely simple and flexible one. In any subject which, like pathology, is still so unsettled, scientifically primitive, and rapidly changing in classifications, any attempt at a highly complex and fixed classification must be discouraged, and descriptive records kept as simple and concise as possible, so that anyone, no matter what his viewpoint is in regard to the nature of the lesion, may easily locate and understand either the record or the label on the specimen.

STAFF[2]

PATHOLOGY

One professor (Director of the Institute)
Three senior scientific assistants
Two junior scientific assistants.

BACTERIOLOGY

One assistant professor
Two scientific assistants
Two technical assistants

MEDICAL JURISPRUDENCE

One professor

Besides the professional staff, the Institute employs three technicians, two stenographers, and one boy in the departments of pathology and medical jurisprudence; one curator, one preparator, and one boy in the museum; and one janitor, one night watchman, and two cleaners.

[1] Gross, Louis. The blood supply to the heart in its anatomical and clinical aspects. New York, Paul Hoeber, 1921.

Segall, H. N. Experimental anatomical investigation of blood and bile channels of the liver. *Surgery, Gynaecology and Obstetrics*, August, 1923, pp. 152-178.

[2] Besides the staff of the Institute, the Department of Pathology in the University includes one associate professor of pathology and three scientific assistants at the Montreal General Hospital and an associate professor of parasitology with quarters in the medical building.

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EXPENDITURES (ESTIMATED) FOR 1924-1925

A. In the Institute

Salaries and wages	
Scientific staff	$17,600
Technical staff	5,450
Clerical staff	1,800
Supplies, new equipment, etc.	6,025
Maintenance of building	
Janitorial staff	4,200
Light, heat, power, repairs, insurance, etc.	23,100
Total	$58,175
To this is added by the Royal Victoria Hospital for salaries, wages, and supplies	$ 6,420

B. In the Montreal General Hospital[1]

Salaries paid by the University	$ 4,800

C. In the Old Medical (Central) Museum

Salaries and wages	$ 1,200

Plans for Future Development

At present the organization, staff, and budget for the departments in the Pathological Institute are still fluid, and not definitely settled. It is hoped, however, to develop a more permanent organization soon and establish special subdivisions in important lines of pathology and bacteriology, which are to be placed in charge of men of mature experience with the rank of assistant professor. A beginning has already been made in the appointment of Dr. Waugh, who presides over the division which deals with the hematopoietic system, and who is the pathological consultant to the Hospital on this subject.

By means of joint meetings for the discussion of interrelated subjects an endeavor is being made to bring about better association and contact between the pathological staff and representatives of the biological and exact sciences, such as botany, zoology, biochemistry, physics, and physical chemistry. It is the object of the present Director to have pathology no longer regarded as merely a medical or premedical subject or only as a hospital aid, but as a science of equal importance to students in all faculties as a cultural subject of higher learning.

In order to realize these plans there is urgent need of material support for the creation of permanent, well-trained scientific and technical staffs. As the financial resources of the Institute increase, its material and advantages can be placed before an ever-widening circle of students and graduates for scientific training and special investigations.

[1] Supplies and technical help furnished by the Institute as requisitioned.

Received for Publication October 29, 1924

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THE PATHOLOGICAL LABORATORY OF THE JOHNS HOPKINS UNIVERSITY AND HOSPITAL

BY

WILLIAM G. MACCALLUM, M.D.

PROFESSOR OF PATHOLOGY AND BACTERIOLOGY

Late in the autumn of 1920 fire broke out in the upper stories of the old Pathological Laboratory of Johns Hopkins University and destroyed so much of the building that it was deemed necessary to tear it down and build a new laboratory on the same site. This was later made possible by a generous gift of $400,000 from the General Education Board, together with $200,000 devoted by the Johns Hopkins University to that purpose. After a year spent in making plans, the new building was begun about the beginning of 1922—the Department being meanwhile housed in various rooms—and was formally opened on November 1, 1923, with addresses by President Goodnow and Doctors Welch, Flexner, and MacCallum.

DESCRIPTION OF BUILDING

The laboratory is so new and the arrangement and equipment have already been so much changed and improved that it is felt that its present status by no means represents its possibilities. Indeed, in the whole plan the underlying thought was of the needs of those who

FIG. 1.—THE PATHOLOGICAL LABORATORY, WITH THE ONE-STORY AUTOPSY ROOM, WOMAN'S CLINIC, AND PHIPPS PSYCHIATRIC CLINIC BEYOND

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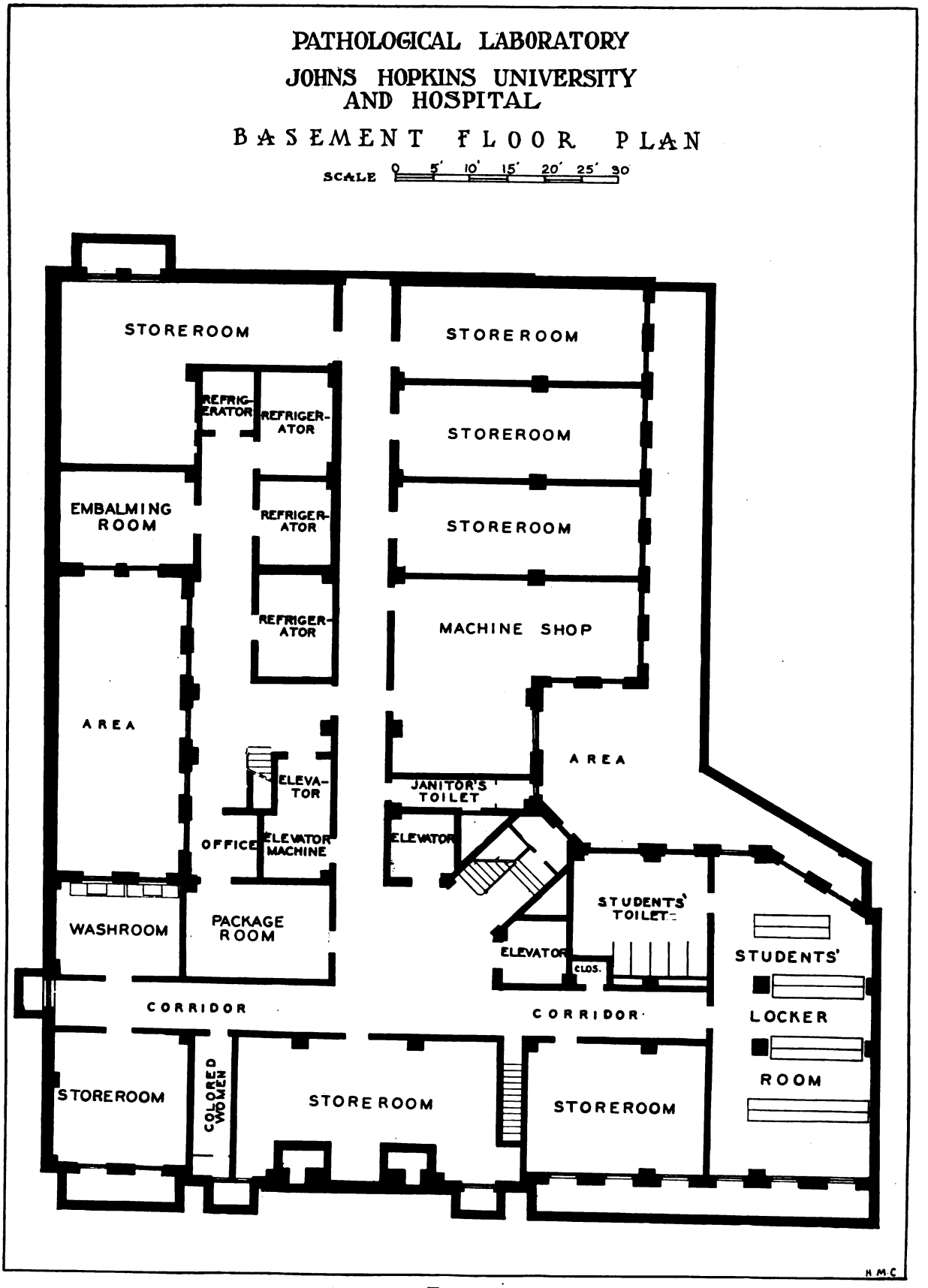

FIG. 2

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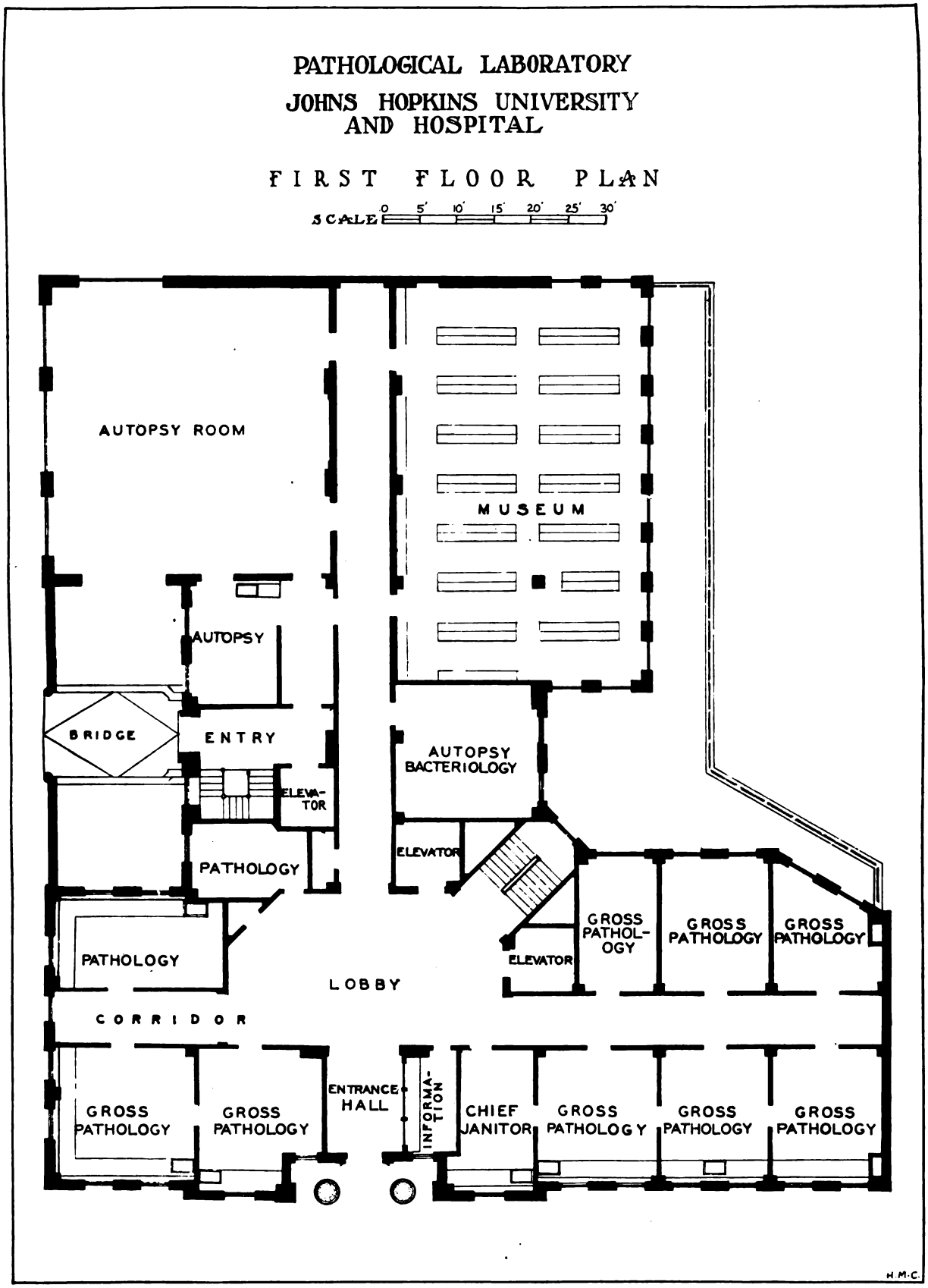

FIG. 3

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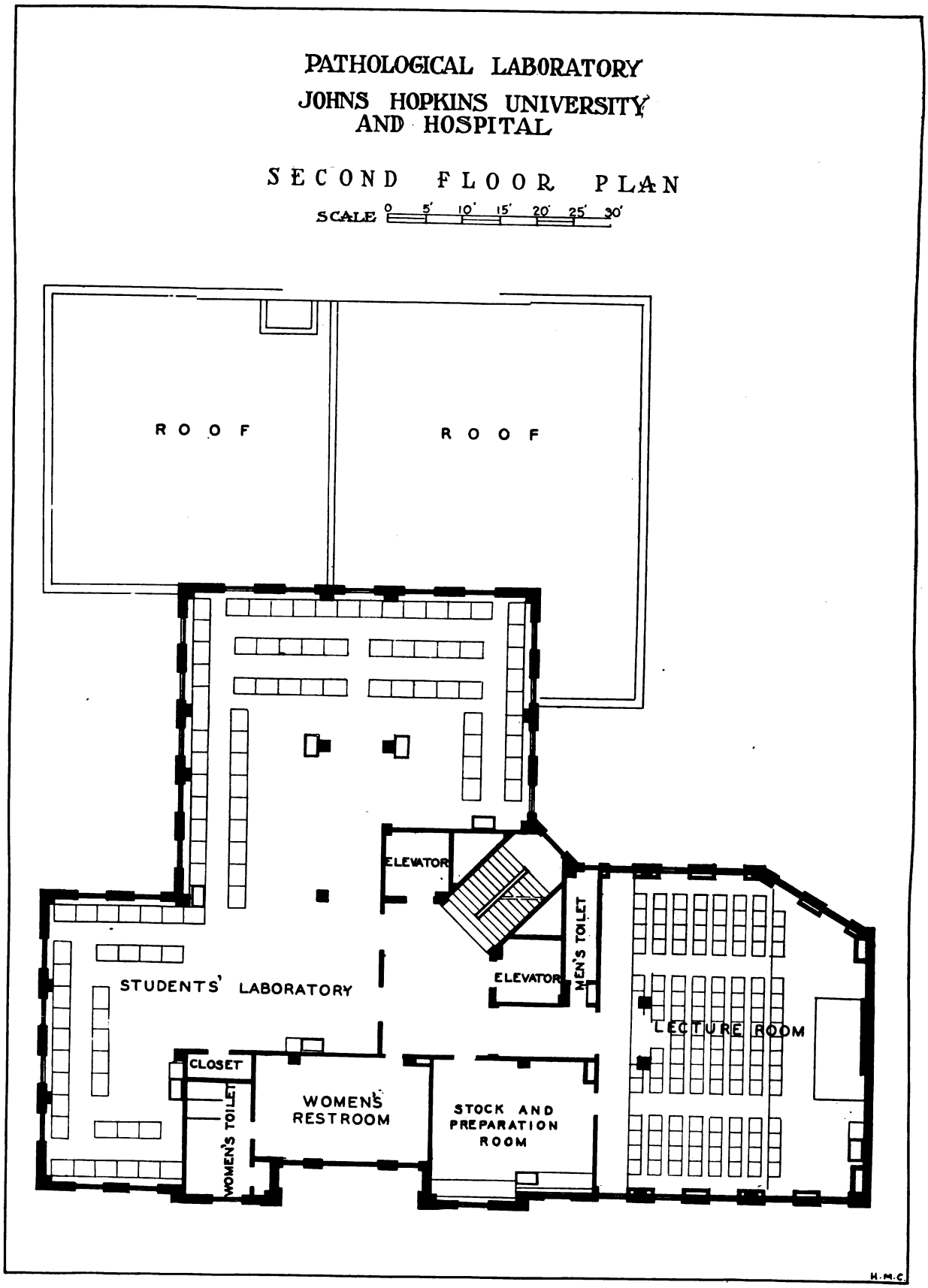

FIG. 4

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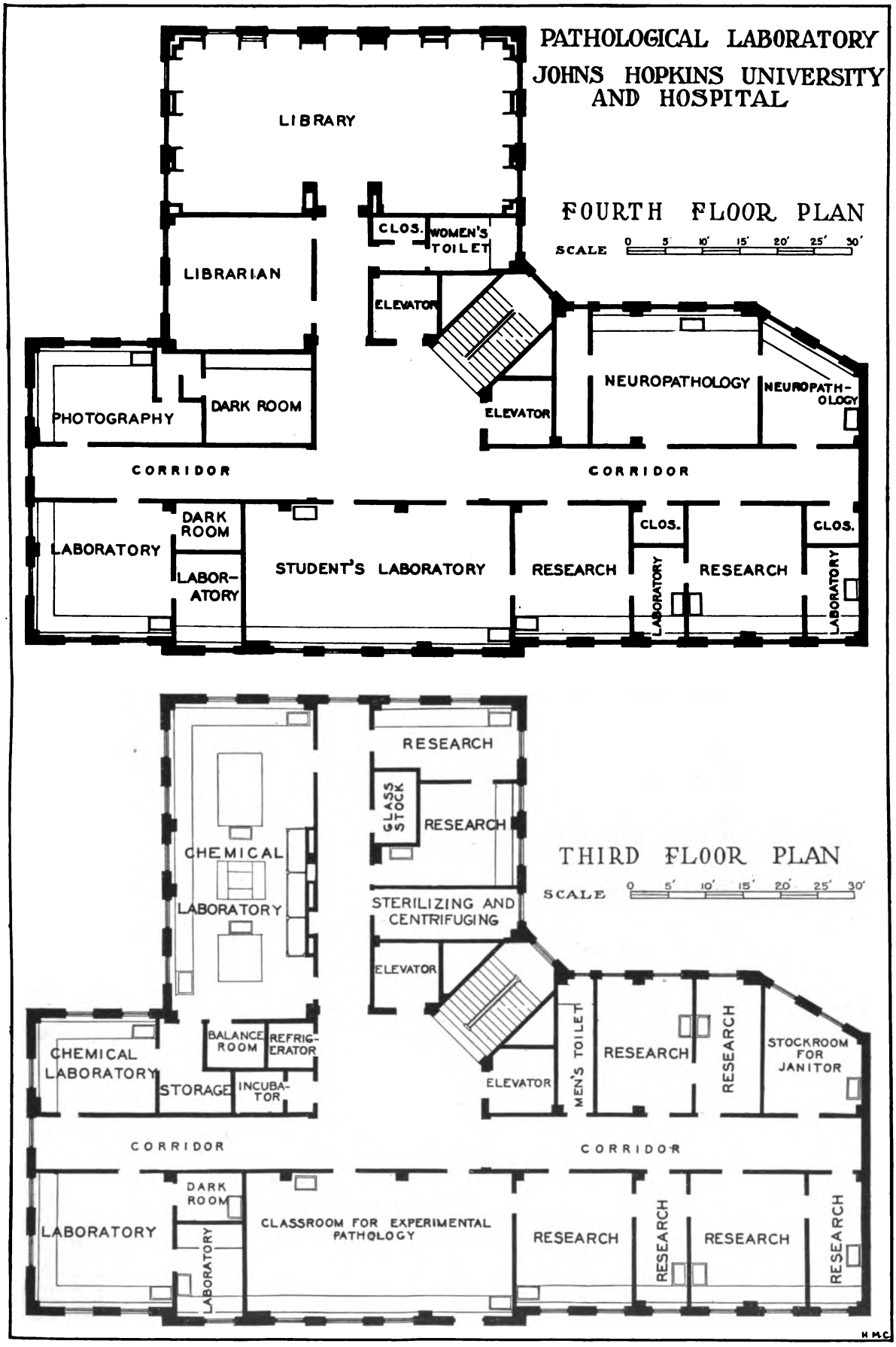

FIG. 5

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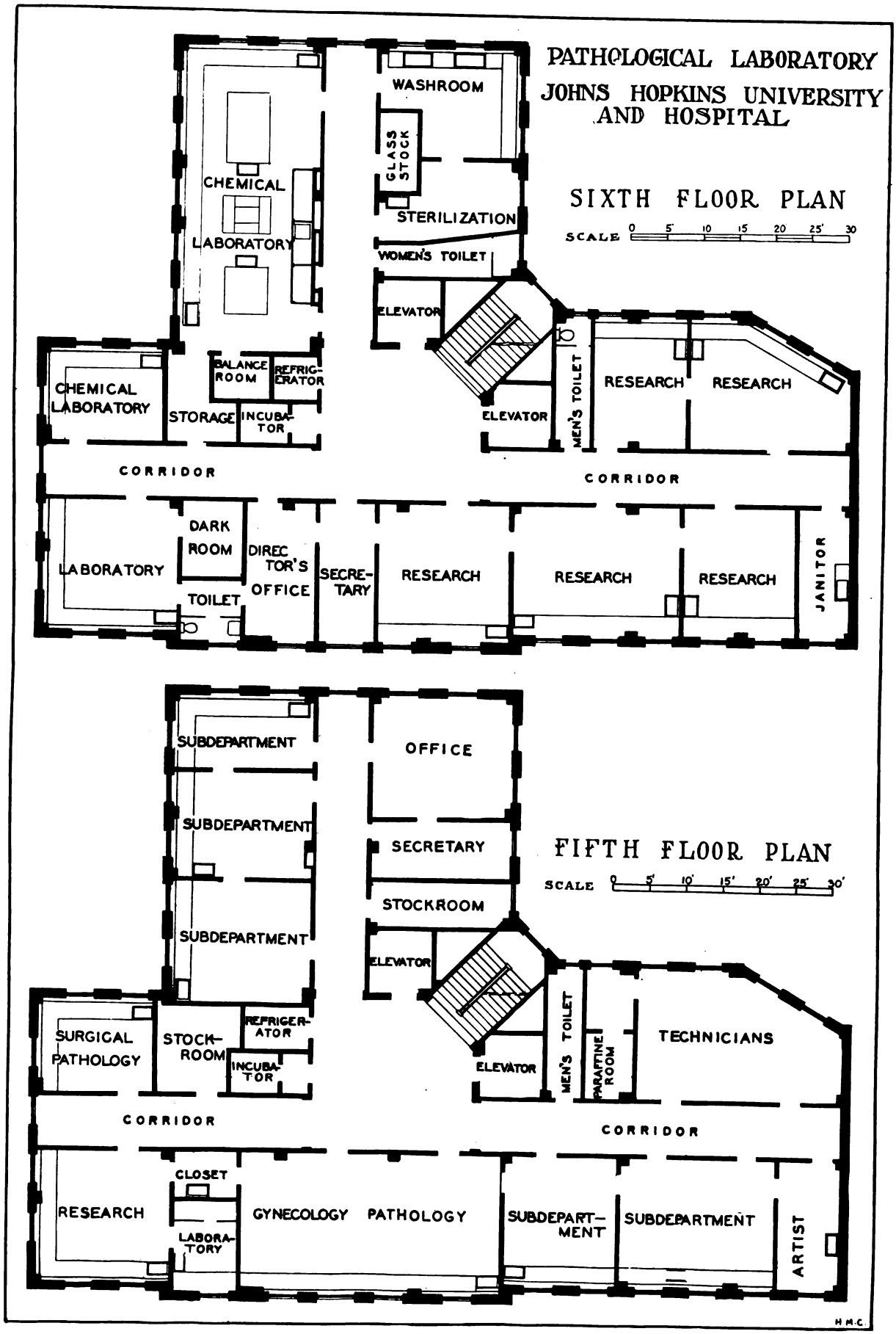

FIG. 6

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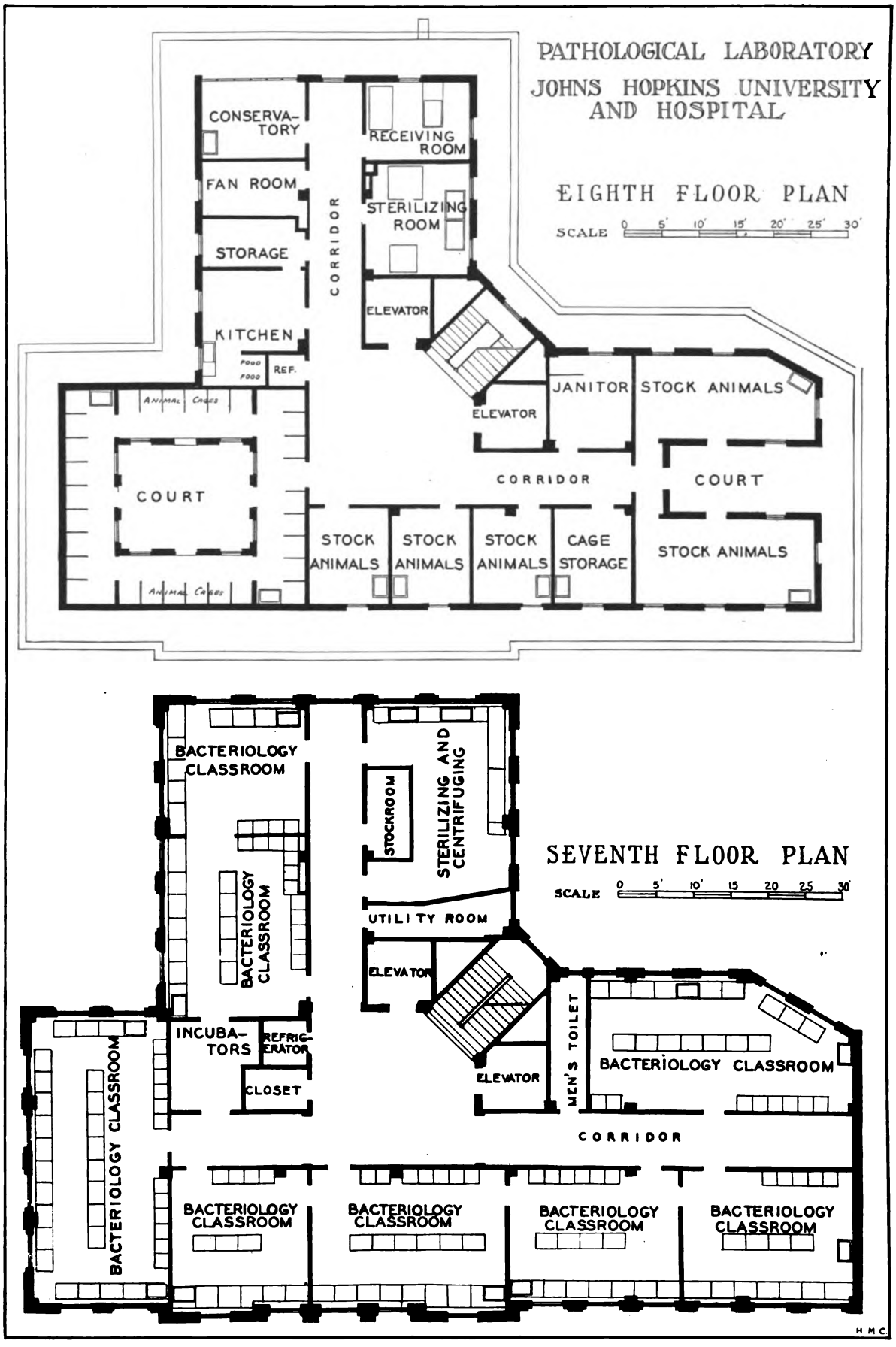

FIG. 7

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might be working in it twenty or more years hence and the attempt was made to build in such flexible form that almost any changes could be made very easily, and to arrange rooms on such a non-committal basic plan that they might well serve for almost any kind of work. As far as we could form a conception of what might prove necessary, we tried to plan an Institute of Pathology and Bacteriology in which every aspect of these sciences could be adequately represented. Thus it seemed that arrangements should be made for work on the pathological anatomy or chemical pathology of plants as well as animals, and for every sort of experimental study of both, as well as for the more definitely established pathological anatomy of the human being dying in the hospital. In that more strictly anatomical work it was attempted to gather in sub-departments the special pathological anatomy from each clinic and at present this is accomplished for the surgical, gynecological, laryngological, ophthalmological, and dermatological clinics.

The building is nominally seven stories high but there is an eighth story set back about six feet from the cornice all round, a basement, and a sub-basement. It is very plain externally, built of brick with stone trimmings, and is irregularly T-shaped, one arm of the T being longer than the other. The angle of the T where the stairs are situated is truncated to admit of windows which throw light into the central space on every floor. There is an elevator on each side of the stairway. The building has a frontage of 105 feet and extends back 90 feet. The autopsy room and the museum, which add another 40 feet southward toward the hospital buildings, have only one story. Although the basement extends under them they do not form a part of the main building (see Fig. 1).

Basements

The sub-basement is entirely occupied by apparatus under control of the engineer of the hospital, such as electric switchboards and various regulators of heat and water supplies. It communicates with the rest of the hospital and with the new power plant by very deep tunnels. A narrow stairway leads to the basement.

The basement contains many storerooms, a room for the refrigerating engine, and the morgue with three large refrigerated rooms for bodies and a smaller one for tissues and specimens. These are simple square rooms kept at a temperature of about 4° C. Bodies are rolled in from the hospital through the basement corridor on high, single trucks with rubber-tired wheels, which take the place of shelves or boxes. The refrigerating engine sends ammonia through pipes not only to the four rooms in the basement but to other rooms placed in a vertical series on the third, fifth, sixth, seventh, and eighth floors. Opposite the morgue there is an embalming room for all bodies upon which autopsies have been performed. For many reasons it has been found desirable to employ a licensed embalmer as autopsy assistant and caretaker of the morgue, and before they are delivered to the undertakers all bodies are carefully embalmed and prepared for burial. In the basement there are also a locker room with toilet for the men students, a room for washing glassware, a stockroom for glassware and all kinds of small apparatus, and a machine shop equipped with precision lathe, drill press, band-saw, etc.

First Floor

The first or ground floor is mainly occupied by two autopsy rooms, the museum, and ten small rooms for the teaching of gross pathology. One of the autopsy rooms is about 40 feet square; the other opening from it is quite small. They communicate with the main corridor and also with a secondary corridor at the end of which is a special elevator leading to the basement. There is a door at the end of the secondary corridor to which the undertakers back their wagons or cars over a bridge which spans the sunken area. The undertakers do not enter the main building but wait in a room in the basement reached from this corridor by stairs. No special chapel has been provided because in the course of years it had seldom or never been required.

The main autopsy room has tiled floor and walls except for a part of the wall which forms a screen for projection. Although it has five very large windows reaching to the ceiling and constituting practically the entire east wall and half of the north and south walls, the lighting is extremely unsatisfactory. The skylight which in a former room of the same size gave an excellent light was left out of this one because the heat was intolerable in the summer. Artificial light from the so-called daylight lamps seems to be satisfactory. There are connections for three tables and students range themselves on movable stands made of piping with wooden steps. For purposes of demonstration satisfactory light is supplied to each of these stands by inverted troughs filled with milky globes; a

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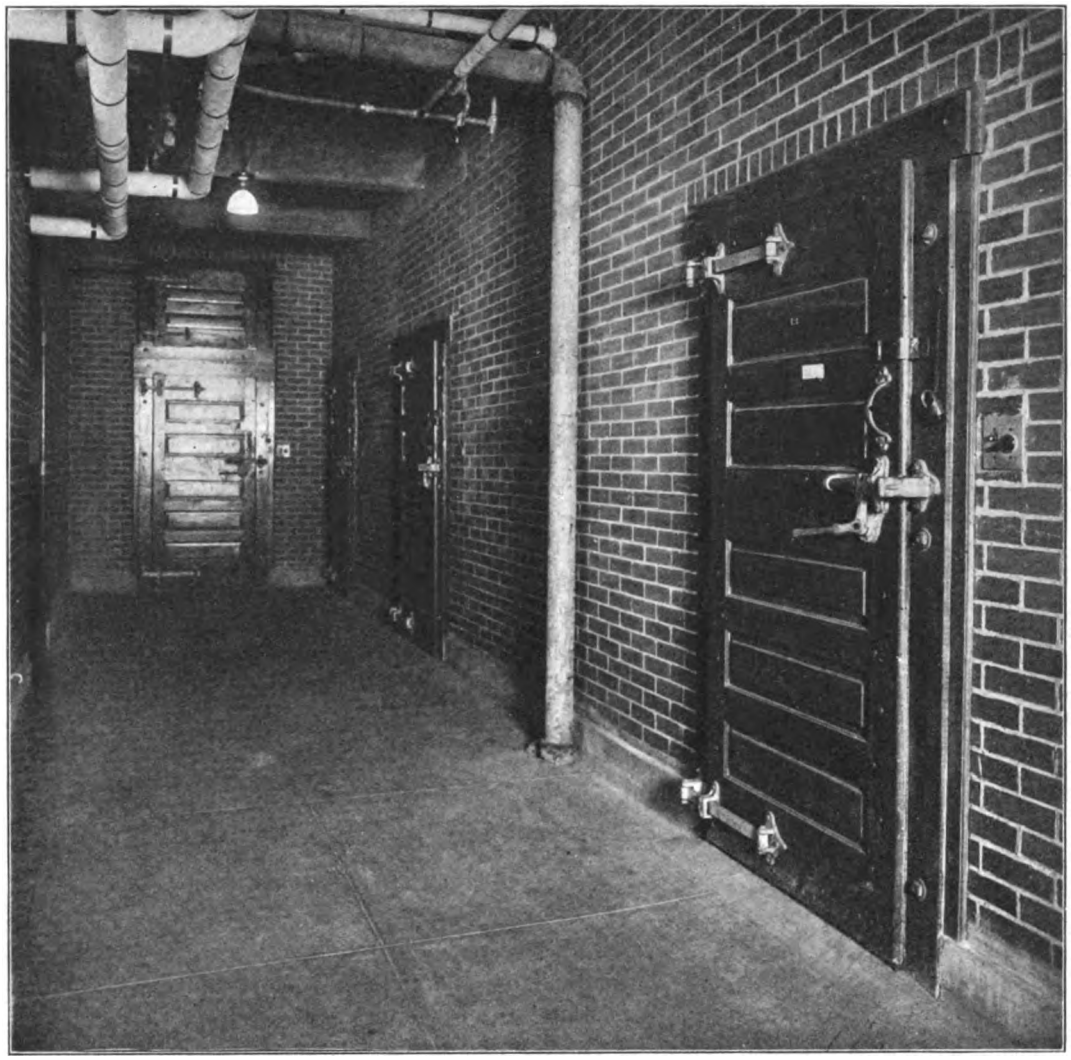

FIG. 8.—MORGUE, BASEMENT: THREE COLD-STORAGE ROOMS AND SMALLER ONE FOR TISSUES

switch is attached to each stand. The small room is similar except that it has no stands for students.

Across the corridor are the museum and a laboratory for the study of the bacteriology of the autopsies. The latter is equipped with ordinary bacteriological apparatus, thermostats, etc., and is to serve for the routine study of materials from autopsies at whatever hour they occur, while more difficult or protracted studies may be transferred to the general bacteriological laboratory on the sixth floor. The museum occupies a large room, not very brilliantly lighted, which serves chiefly as a storeroom for specimens, since the whole collection is looked upon rather as working material than as an exhibition for casual visitors. Communicating with this is a room for the preparation of museum specimens equipped with a very large sink furnishing a continuous flow of water for the protracted washing of tissues. This sink has proved particularly valuable in allowing museum specimens to wash until all formalin is removed so that when the color is brought back by the Kaiserling method it is not later caused to fade by formalin which has remained in the insufficiently washed tissues. The sink is of alberene, 6 feet long, 18 inches deep, and 15 inches wide, with supply pipes running along the bottom at each end and sending jets of water toward the centre through many large perforations. The escape is over the top of a pipe inserted into the central

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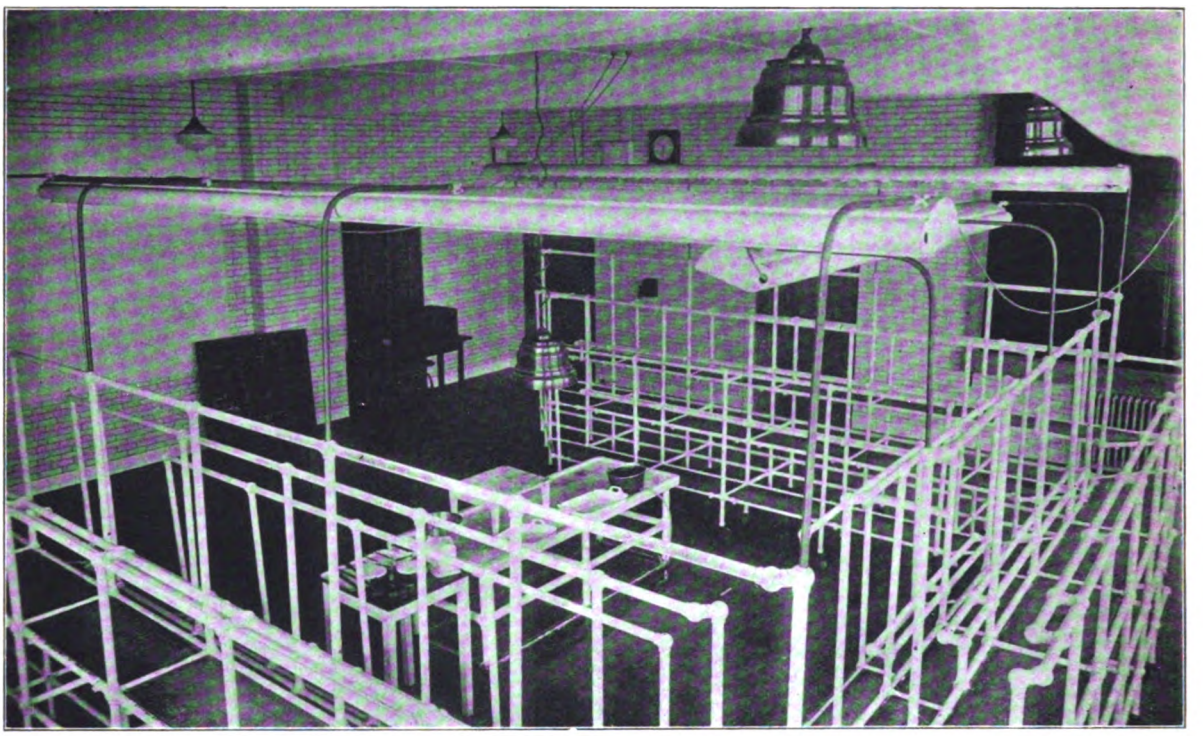

FIG. 9.—LARGE AUTOPSY ROOM, LOOKING DOWN FROM TOP OF STUDENTS' STANDS. ONLY ONE AUTOPSY TABLE IN PLACE. INVERTED TROUGHS WITH INCANDESCENT LIGHTS ATTACHED TO EACH STAND

waste vent and reaching nearly to the top of the sink where it is capped with a wire basket.

The remainder of the first floor is divided into ten rooms, about 15 feet square, which serve for the teaching of the more special pathological anatomy to students in small groups in a way to be described later. They are provided with dark curtains and lined to the ceiling with steel shelving. Each has one or two tables, one for the demonstration of gross pathological material under a strong light, the other for microscopic projection on a translucent screen.

SECOND FLOOR

About one half of the second floor is taken up by a large laboratory for microscopic work for the whole class, in which each student has his locker and desk. There are also a restroom and toilet for women students and a preparation room occupied by the chief technician who is largely concerned with supplies and the preparation of stains, reagents, etc. Finally, there is a lecture room which will hold from 130 to 150 people. There is nothing peculiar about it except perhaps the dark curtains operated by an electric control—an expensive and fragile apparatus which might well have been replaced by students. There is an elaborate and very expensive projection apparatus of the old style which is far surpassed by the more modern and cheaper forms in use downstairs.

THIRD FLOOR

The third floor was especially designed for experimental researches involving operative work on animals; there is, therefore, a sterilizing room for dressings and instruments. Every room is supplied with compressed air for artificial respiration, filtering, etc., furnished by an ordinary automobile tire pump standing in one of the rooms, which works automatically up to a set pressure.

Some of the rooms on this floor are in suites of two, one large and one quite small, an arrangement that has been found very convenient for the individual worker. In other cases two men occupy a suite of one large room and two small ones. As all the rooms communicate with each other, the doors can be closed to make any grouping desired. One large room is for classwork in some form of experimental pathology. The southeast portion of the floor is occupied by

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a chemical laboratory which is fitted up in the usual way. It has a small inner room for balances and an electric fan on the eighth floor to exhaust the fume cupboards, etc. In the corridor opposite is a closet for glassware, while a room which forms the passageway to a smaller chemical laboratory constitutes a small stockroom for chemicals. This whole arrangement is repeated on the sixth floor in the Bacteriological Department where, however, it is very differently used. At the angle of the corridor are two constant temperature rooms, one kept at 37° C. and the other at about 6° C. Similar rooms are also found on the fifth and sixth floors.

Fourth Floor

The fourth floor is largely made up of individual workrooms which extend along the north front, although one large room corresponding with the classroom for experimental pathology on the third floor is for the use of students who wish to carry on any kind of investigation. For concentrated work on neuropathology there is a suite of three rooms where all the neuropathological material from the autopsies is collected.

A photographic laboratory with an inner dark room arranged after a study of model dark rooms and approached by a labyrinth lies on the other side of the corridor. Near this is a room occupied by the clerical force, in which are kept in a large cabinet all the microscopic preparations from past autopsies and the bound and unbound protocols of the autopsies. The south end of the floor is occupied by the library of the Department which is a pleasant room with wainscoted walls, beamed ceiling, and a large open fireplace. The book shelves are between the windows and on the back wall (Fig. 13).

Fifth Floor

The fifth floor is mainly occupied by various subdepartments. An attempt has been made to give to each clinical department an established laboratory concerned with the pathological anatomy of the material derived from its operative work. Thus, the Department of Gynecology is housed in a large room in the middle of the north side. Near by, ophthalmology is well established, with a large collection of gross and microscopical material, and the same is true of laryngology. Surgical pathology occupies another room but since there is already a very large and well-ordered museum of surgical pathological material this is a room to which the current surgical material can be brought each day for technical preparation and study by the surgical pathologist

Fig. 10.—Large Laboratory for Students' Microscopical Work, Second Floor

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who is at the same time a member of the surgical and pathological departments. After the material has been demonstrated to the Department of Pathology it is returned to the surgical pathological museum for preservation in its proper place. This plan works very well. Other rooms are set aside for similar subdepartments of dermatology, the pathology of plants, of domestic and other animals, and so forth, which will be developed as soon as suitable persons are secured for the work. On this floor there is also a large workroom with a smaller room adjacent for the several technicians who prepare and stain the microscopical sections from all autopsy cases.

workrooms, with the exception of one or two which serve as offices.

The seventh floor is occupied by teaching laboratories of which there are eight, the largest accommodating twenty-four students, the smallest only eight. There are places for one hundred in all, although the class in bacteriology numbers about eighty. These rooms have communicating doors so that an instructor may easily supervise more than one at a time. There are certain advantages in this arrangement, less disturbance of the student by other members of the class, less commotion and attendant dust, and more concentration on the part of the stu-

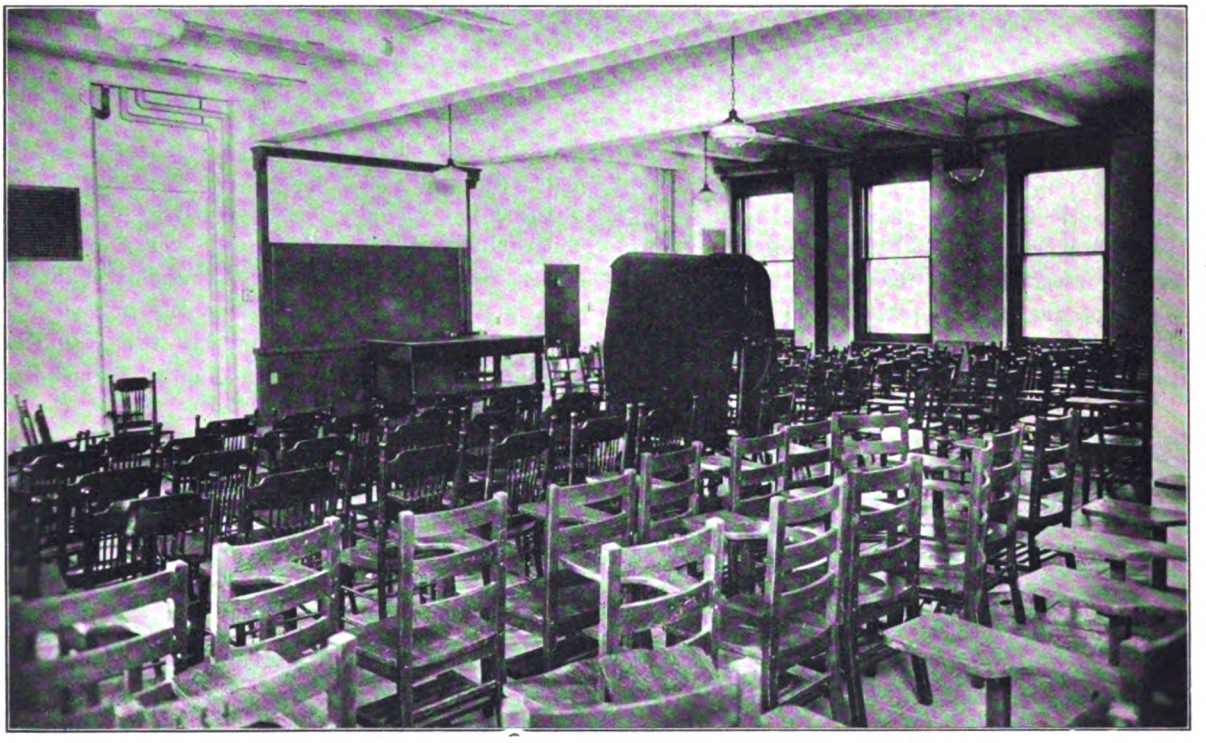

FIG. 11.—LECTURE ROOM FOR STUDENTS, SECOND FLOOR

SIXTH AND SEVENTH FLOORS

The sixth and seventh floors are devoted to bacteriology, the sixth being occupied by laboratories for the prosecution of investigations while the seventh is used for teaching.

The sixth floor is almost exactly like the third in its general plan, the chemical laboratories being identical and the arrangement of the various workrooms very similar. There is at one corner a large room for the making and sterilizing of bacteriological media, the glassware being cleaned in a similar room just above on the seventh floor. The other rooms are equipped as

dent. One classroom is reserved for exhibits and demonstrations which the students from each room study in turn. The furnishing, though adequate, is extremely simple, and great care is taken to ensure cleanliness by insisting that the student may not accumulate unnecessary cultures or apparatus.

EIGHTH FLOOR

The eighth floor is designed for the housing of animals and is so arranged that a sort of alley runs all round it with an outer wall about four feet high. This story is thus set back about six feet from the wall of the main build-

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ing. The court for dogs is open to the sky, with a well-drained tile floor. Surrounding it is a glass wall with several doors which open into a narrow corridor the outer wall of which is formed by two tiers of cages. These were copied from those in the Rockefeller Institute for Medical Research. They have alberene floors, without drainage, and can be kept clean only with the expenditure of much labor and a great deal of sawdust or shavings. There is another court of rather different shape flanked by two large rooms where other animals such as sheep and monkeys are kept. Between the two courts on the north side are several rooms for rabbits, guinea-pigs, and other smaller animals, fitted with cages on swinging frames so that they are quite separated from floor and walls. The rest of the floor is occupied by rooms for bathing animals and for sterilizing cages in large steam sterilizers, a kitchen for cooking food for dogs and a storeroom for food for other animals, a room for the animal caretaker, another for the exhaust fan, and a small conservatory for the future sub-department of plant pathology.

Not many technical innovations are to be found in this building. The dark room in the photographic laboratory is extremely satisfactory. It was modified slightly from the plans given by the Eastman Kodak Company for a model dark room and the work of developing plates, etc., is made especially easy by the breast-high sink which with its various compartments stretches along one whole side of the room. This is deep, too, but is covered by a wooden rack upon which developing trays rest under the red light. Photographs of gross specimens made under water are used for lantern projection but much more use is made of large sections mounted on a lantern slide and projected on the screen. These sections which may show the whole length and breadth of a child's lung, or a cross section of an adult kidney can be made as thin as other sections and are very beautiful when projected. They convey a wonderful impression of the topography of pathological lesions. We have devised a special microtome to cut them and this machine, which was made for us by Bausch & Lomb, is described in *Bulletin X* of the International Association of Medical Museums (1924, p. 87).

LABORATORY ROUTINE

Between five and six hundred autopsies are performed annually and an effort is made by the whole staff to preserve careful records and to make the gross and microscopical preparations from each case as complete and permanent as possible. Although jars, fluids, and storage space are very costly, a representative slice of each organ from every case is preserved in colors, i.e., the heart and aorta, half of each lung, a slice of spleen, liver, kidney, and so on. These are not mounted as isolated museum specimens but are kept together in a stoneware crock upon which the number of the autopsy is painted in large black figures on a white ground. Small selected slices from each tissue are fixed in various ways for microscopical study and these are kept in glass jars with the autopsy number stamped in large figures in printer's ink on a card put inside the jar. This is also expensive but the collection, which is pretty complete from autopsy No. 1 on, is an invaluable source of information when the series of cases representing some disease is to be studied.

Each member of the staff on finishing an autopsy writes a provisional anatomical diagnosis with his protocol. It seemed desirable that one person should closely supervise all autopsies and once a week the entire staff meets with the professor of pathology who goes over the organs preserved from the cases of the week, dictating a brief note expressing his opinion as to the significance of the conditions found, or perhaps adding a note on anything not before observed or not understood. Such notes later recall the whole case in brief summary in a very useful way. The staff meets again on Thursday evening of each week about a table upon which there is a projection lantern with translucent glass screen, and each man demonstrates on the screen the microscopical sections from the cases he has studied. If necessary the gross organs are again surveyed in this connection and again the professor dictates a brief note summarizing his opinion as to the significance of the case from this more minute study. Bacteriological reports are available and every member of the staff is asked to take part in the discussion. This conference has been found extremely useful in many ways. Finally, when all these notes are typewritten, together with the protocol, the records are bound together in books of one hundred cases each, including a complete typewritten index, arranged alphabetically with cross references, much like the index of a printed volume. Ten indexes are later combined, making one index for each thousand autopsies. The plan of these indexes has been evolved gradually and it is scarcely necessary to say that a combination of indexes to hundreds of autopsies has been

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made possible only by the adoption of a certain uniformity of terminology.

Another gross and microscopical staff conference is held on Wednesday when the men working in the subdepartments of surgery, ophthalmology, etc., bring their more interesting material for exhibition and criticism.

On Monday afternoon at five a more formal conference is held for the discussion of two or three cases which have been of especial interest. This is attended by the clinical staff and internes of the whole hospital and by many physicians in the city who are not officially connected with it. The pathologist presides and asks for the clinical history of the case in point, after which there is discussion of its clinical aspects. Then the tissues are demonstrated and microscopical preparation projected on a large scale. Similar cases are brought up for comparison and there is general discussion.

Similar to this, except that it forms a regular exercise for the fourth-year class, is the clinical pathological conference which has been held on Wednesday morning by Drs. Thayer and MacCallum for many years. The chief purpose of this conference is to demonstrate methods of clinical diagnosis controlled by autopsy but it also serves to present important cases most of which have been seen in the wards by the students.

TEACHING

Students of the second year attend courses in pathology and bacteriology. The time available seems always much too short since the study of pathology lasts through two thirds of the academic year and that in bacteriology through only one third. In general it is planned to offer the student abundant opportunity to learn rather than to give him insistent instruction. For example, the students are invited to assist in small groups with the performance of autopsies and to pursue the study of these cases in any direction in which their interest may be aroused. A general course is given with lectures and demonstrations of illustrative gross material to the whole class and this is pursued in systematic order throughout the two trimesters allotted. A collection of about three or four hundred sections is rented to each student for the year for the miscroscopical study which accompanies and really constitutes a large part of the course. Although these preparations are carefully selected and stained, opportunity is

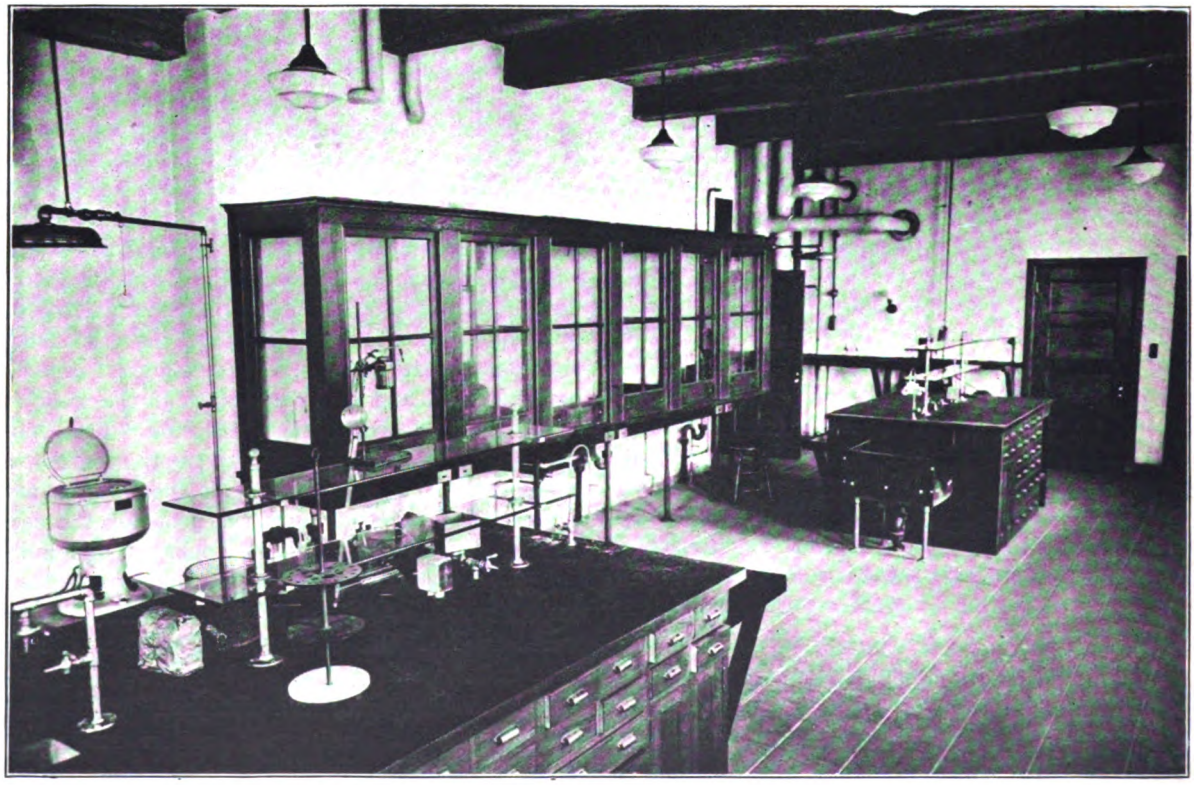

FIG. 12.—CHEMICAL LABORATORY, THIRD FLOOR

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FIG. 13.—LIBRARY, FOURTH FLOOR

constantly given to every student to make for himself microscopical preparations from current material and thus learn something of the technique. Unfortunately, the great importance of this is not often appreciated.

Although the course of lectures and gross demonstrations is carried on regularly throughout the term, the demonstration of microscopical preparations to the class as a whole is continued in connection with the lectures only up to the point at which the discussion of the general phenomena of disease is completed. That is, after they have studied the effects of disturbances of the circulation, the direct effects of physical and chemical injuries, disorders of the metabolism of cells, and the typical reactions to these injuries, inflammation, repair, etc., a new arrangement is made.

The class is divided into ten groups of six or seven students, which for the rest of the course work in rotation in the ten small rooms on the first floor, so that each group spends about five or six days in each room. When this plan was first tried the instructor who is provided for each room remained throughout the course in the same room, because it was thought that his teaching of the subject represented by the material collected there would be improved by long familiarity. It would be possible, of course, for the instructor to rotate with the students from room to room. It has seemed best, however, in the interest of both instructors and students for the instructors to change rooms three times during the course.

The rooms described above are lined with shelves and provided with a tall steel locker with several shelves. All of the autopsy material preserved in stone crocks or in the form of isolated specimens from the older cases has been reviewed and indexed, and each case presented in a form valuable for teaching the lesions of a disease is assigned to one or another of the ten rooms. This becomes a continuous process by means of the weekly conference upon gross autopsy material, during which each case is considered for its usefulness as teaching material and is either thrown away or assigned to one of the rooms. As at present arranged the rooms are designated for the teaching of the following arbitrary groups of subjects:

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FIG. 14.—OFFICE OF THE PROFESSOR OF PATHOLOGY

1. Arteriosclerosis, cirrhosis of the liver and allied affections, and nephritis.
2. The effects of obstruction in the digestive or urinary tracts, in the circulation, respiratory tract, etc.
3. Diseases produced by bacterial infections.
4. Tuberculosis, with leprosy, actinomycosis, etc.
5. Syphilis.
6. Diseases of unknown infectious origin (smallpox, etc.). Diseases caused by animal parasites.
7. Diseases of the blood-forming organs.
8. Diseases of the organs of internal secretion and diseases of bones and joints.
9. Tumors, with the exception of carcinoma.
10. Carcinoma, teratomata, etc.

Material having been saved for this purpose from about 4,000 autopsies, each room is abundantly supplied with representative cases in great variety and there is already more material than the students can study carefully in the time at their disposal. For each room an analytical index of the cases stored there has been prepared so that the instructor can take down at a moment's notice cases to illustrate any subject under discussion. Such an index must be frequently revised, just as the material itself is reviewed and selected. Even though the minute study of so many cases is impossible, it is nevertheless of great advantage to be able to spread before the group of students at one time twenty cases of tuberculosis of the lungs and other organs in children and at the next meeting a similar collection of cases of tuberculosis in adults. Ten cases of myeloid leukemia make a more intelligible impression than one and a series of cancers of the stomach leaves on the student's mind something of the effect of long experience which the study of a single case cannot give.

The protocol, anatomical diagnosis, and a summary of the clinical history for each case are made conveniently available and the microscopical sections from every tissue are kept at hand in the locker. These are very satisfactorily demonstrated to the whole group at one time by means of small projection microscopes one of which stands in each room. This equipment consists of a small incandescent lamp with concentrated filament mounted in a metal lamphouse, which throws a strong beam of light through an aspheric condenser upon the substage condenser of an ordinary microscope set in the horizontal position. The image, about 18 inches in diameter, is projected upon a glass screen and can be seen with equal clearness on either side. This screen is made by pouring diluted white enamel paint on a sheet of glass

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and allowing it to run off quickly so that only a thin film is left.

This plan of teaching a small group in an intensive way is extremely interesting to the instructor who must himself learn a great deal from the large collection of material at his disposal. It is understood of course that such study cannot take the place of long experience at the autopsy table but it gives a far more comprehensive view of the disease than has been possible with the usual demonstration of isolated specimens to a large class. Experimental and chemical or bacteriological studies can well be carried out with such small groups to illustrate other aspects of the same subjects. A great advantage lies in the fact that the instructor sits down in a separate room with a small group of students and spends the whole day with them poring over a series of cases and discussing everything most informally. Of course he makes an appropriate subdivision of his subject for the five or six days to be spent with the group and has at hand for reference all the textbooks, monographs, and reprints of special articles and illustrations that bear on the disease in question. Apart from this the students have their own loan collection of sections which they study and draw at their desks on the second floor. At the same time there goes on a systematic course of lectures and gross demonstrations to the class as a whole. We thought at first that it might be confusing for the small group to be plunged into the study of carcinoma before the systematic lectures had reached that point but this difficulty has not arisen; either form of study serves as a kind of review of the other. This plan is still in its experimental stage but thus far it has seemed to be extremely satisfactory.

In former years courses in the experimental study of the functional disturbances produced by disease have been given to selected groups of students and have proved to be extremely profitable not only because they teach experimental methods but because they evoke an enquiring attitude and stimulate many students to proceed with the investigation of problems that arise. Such courses have been arranged for on the third floor and it is confidently hoped that the plan may be carried through this year.

A course in bacteriology and immunology is given on the seventh floor during the last trimester of the first year. The time available for the course in bacteriology is three half days for laboratory work and two hours for lectures each week. About thirty minutes of each laboratory period are devoted to the giving of general in-

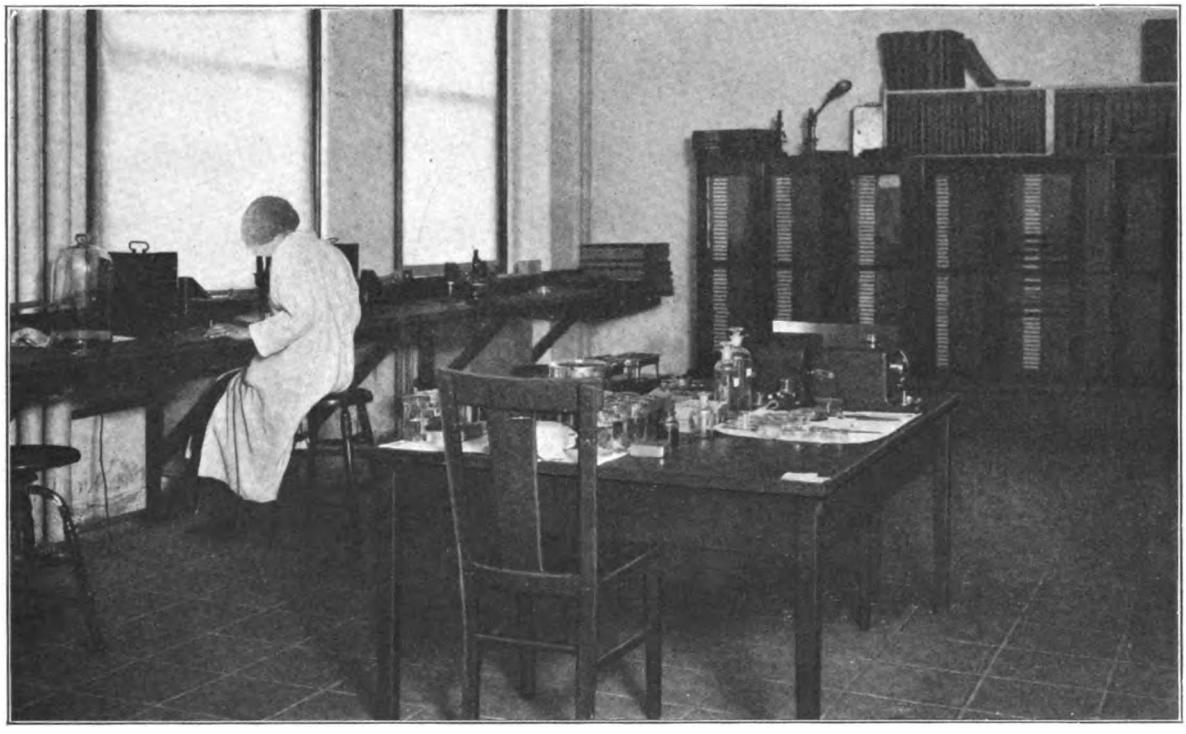

FIG. 15.—CORNER IN ONE OF THE SUBDEPARTMENTS, FIFTH FLOOR

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structions and to practical remarks about the subject of the day's work. The laboratories are always open so that students may come in at any time to make observations on cultures, etc. Many avail themselves of this opportunity. The time allotted to the course is not sufficient to allow the students to make much of their media and stains, or to clean glassware or operate the sterilizers. Only a couple of days at the beginning of the course are devoted to such work; afterwards it is all done for them. The primary emphasis is laid on infections and infectious agents. A certain amount of serology is given in connection with the study of particular groups of bacteria. An elective course in immunology, open to students of the second-, third- and fourth-year classes, and occupying two half days of each week for one trimester, focuses attention upon various immune reactions, technique, and theoretical interpretations.

STAFF

The professional staff of the Department of Pathology and Bacteriology is as follows: one professor, two associate professors, three instructors, six assistants, and five voluntary assistants. There are usually also several fellows, either supported by the Rockefeller Foundation or by the National Research Council. At present there are seven—one from Canada, two from Siam, one from Austria, one from Roumania, one from the Philippine Islands, and one from the United States.

The clerical work is carried on by two secretaries, and by two or three other workers who keep the records of the laboratories in the subdepartments. Similarly, three women technicians cut and stain microscopical preparations from all the autopsies, but each subdepartment has its own technician to cope with the great amount of routine work to be done in connection with the hospital clinics. There is a man to care for the animals on the eighth floor. The bacteriological laboratories have two or three people who act as technical assistants. Two other men assist in experimental work on the third, fourth, and fifth floors, and two boys work chiefly in the basement and are available for any unskilled labor such as washing glassware. One skilled embalmer acts as attendant in the autopsy room. There is also a professional photographer to make all the necessary photographs, but at present there is no artist to make drawings which are much more useful than photographs. The cleaning of the building is done by a staff of five workers managed by the hospital.

BUDGET

The whole budget amounts to $52,000, of which $9,000 is set aside for the expense of supplies and apparatus.

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PEKING UNION MEDICAL COLLEGE DEPARTMENT OF PHARMACOLOGY

BY

BERNARD E. READ, PH.D.

ASSOCIATE PROFESSOR OF PHARMACOLOGY

BUILDING AND EQUIPMENT

The Department of Pharmacology of the Peking Union Medical College occupies the whole of the first floor and half of the basement of Building D (see Figs. 2 and 3). The rest of the building is assigned to the Department of Physiology.

The lecture room (see Fig. 4) has seating capacity for fifty students and is provided with a good balopticon and a demonstration bench. Since lectures occupy but a small part of the schedule, this room is used principally for conferences and discussions.

The preparation room, adjacent, serves as a depository for materia medica specimens and materials serviceable for teaching purposes. At present it is used for work related to the botanical and pharmacognostic side of the research program.

The student laboratory is equipped with two large chemical tables on the north side and one long fixed bench on the south side. Adequate provision has been made for twenty-four students to do both chemical and physiological experiments by the aid of hot and cold water, gas, compressed air, high- and low-voltage circuits, water baths, etc. An electro-cardiograph station connected with the hospital plant is located in this room.

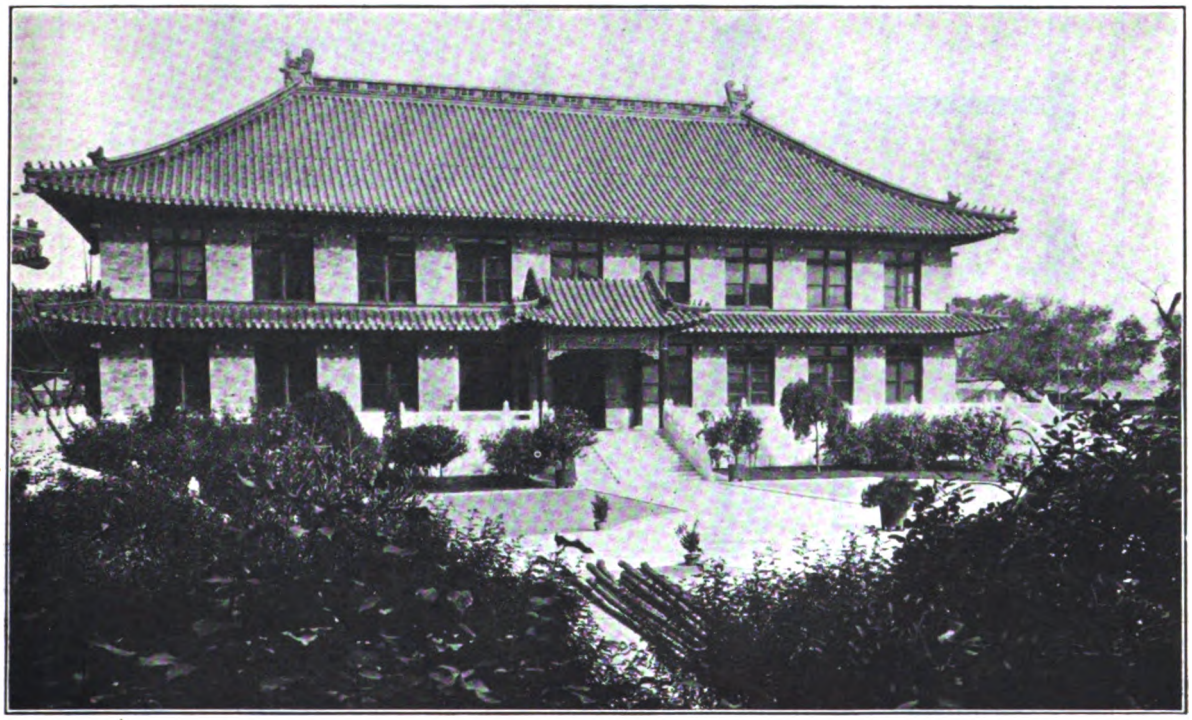

FIG. 1.—PHYSIOLOGY BUILDING

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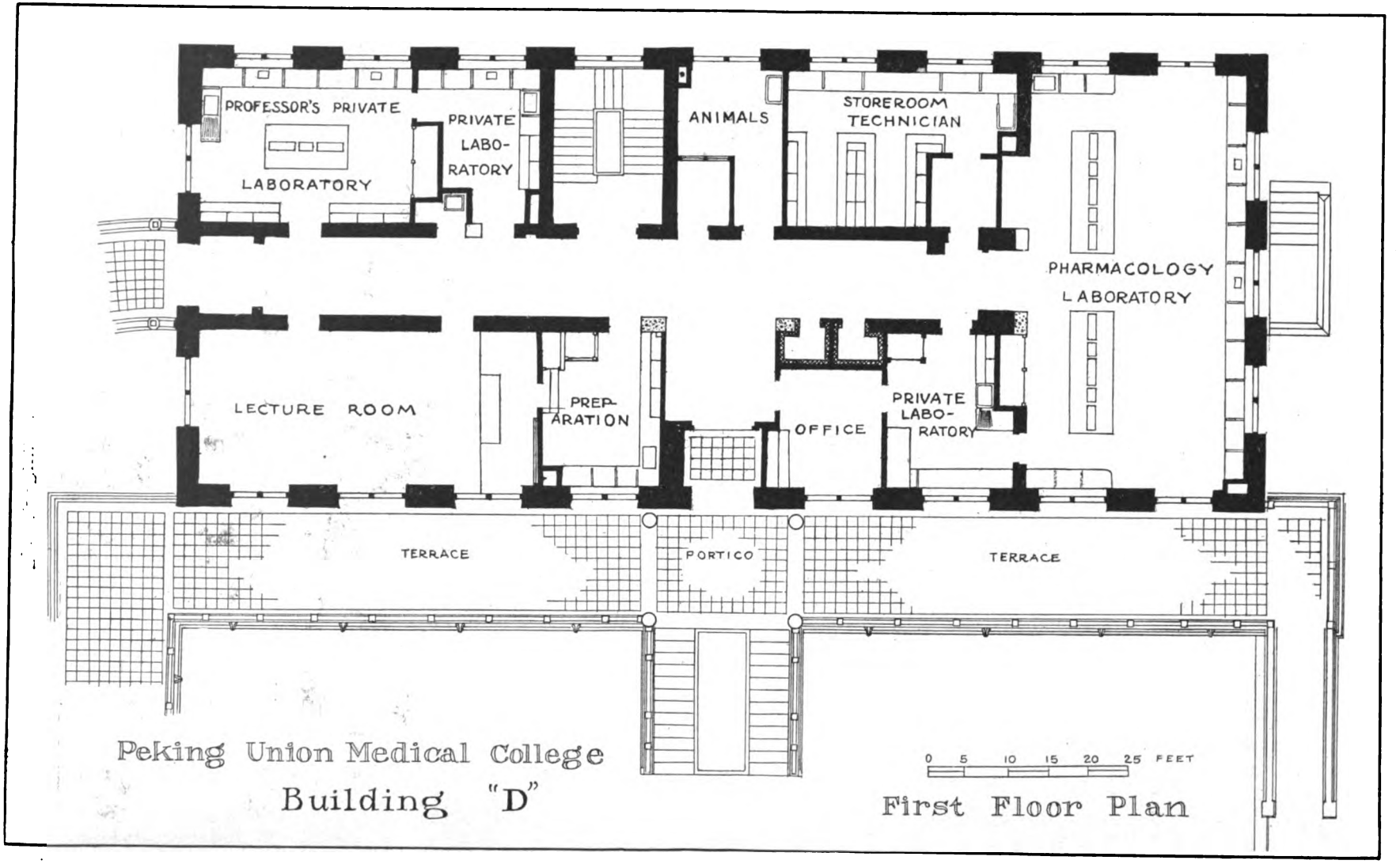

FIG. 2

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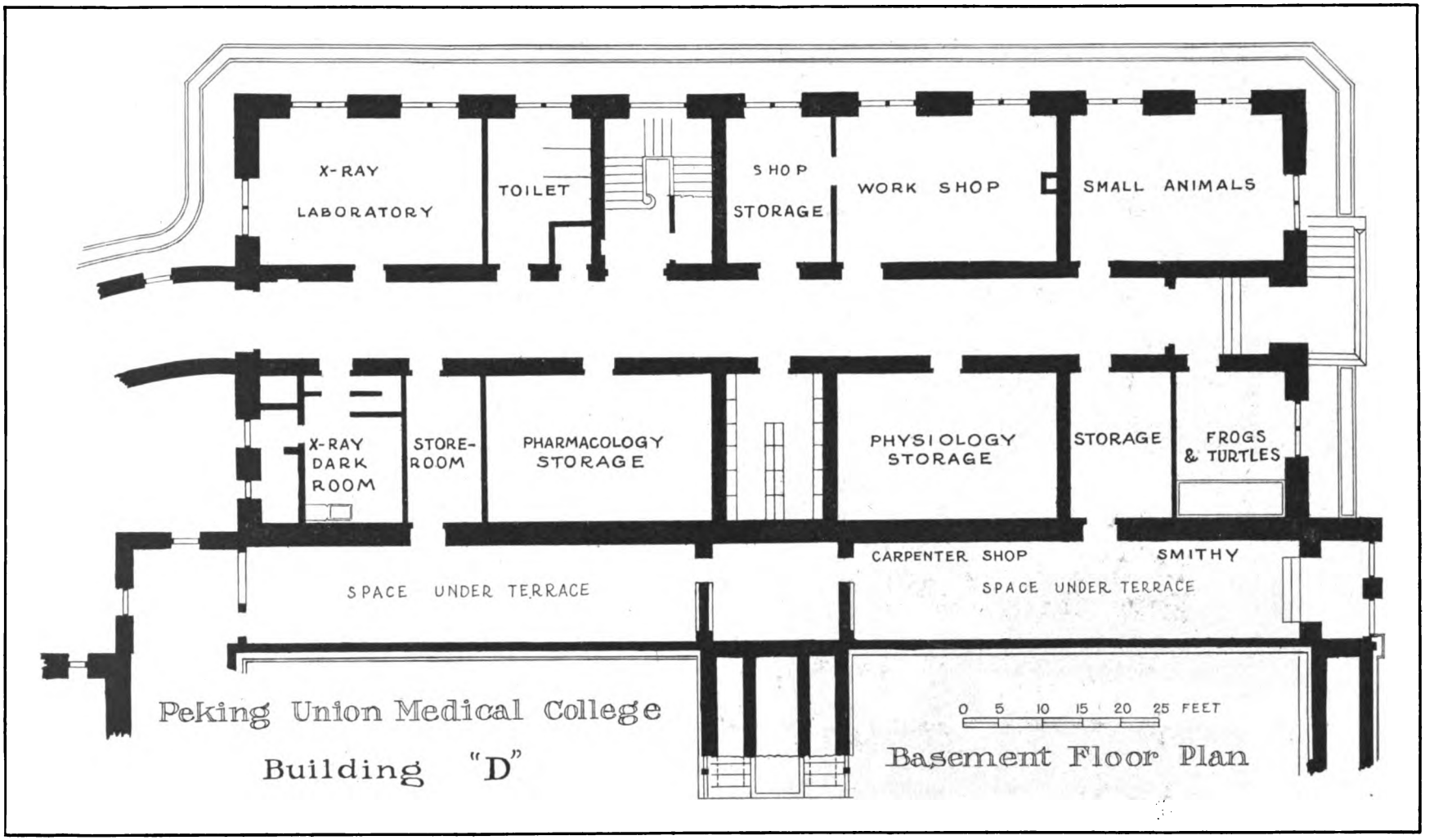

FIG. 3

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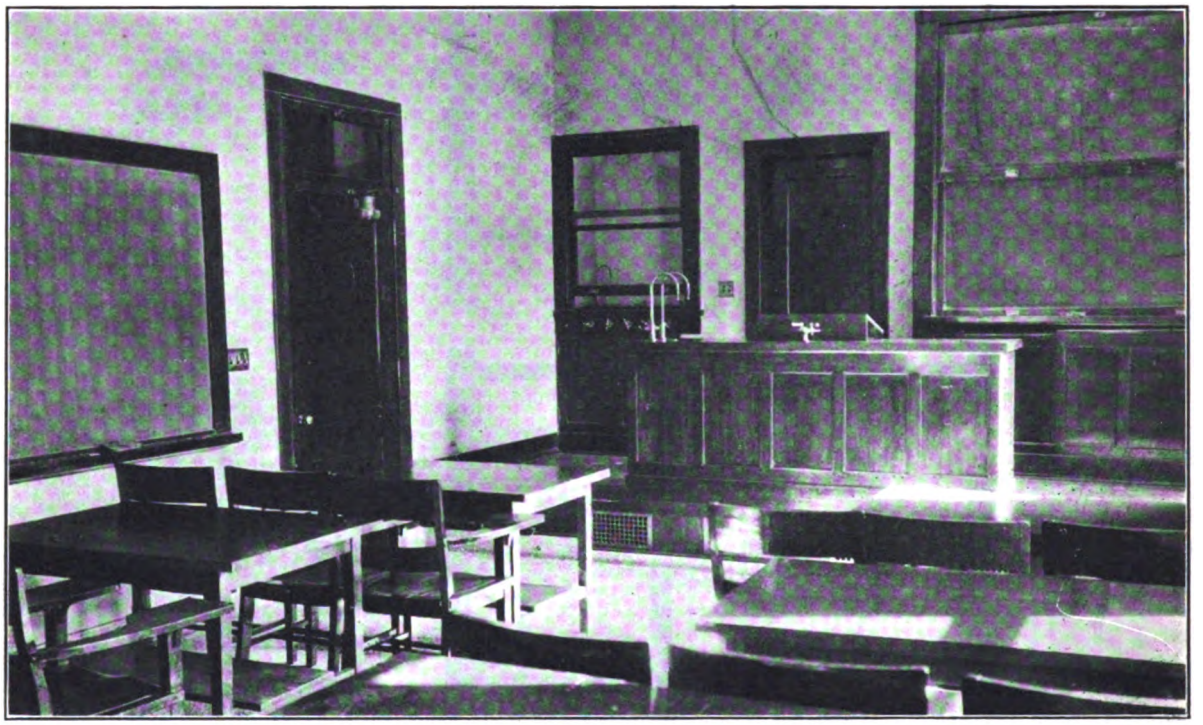

FIG. 4.—LECTURE ROOM

Two private research laboratories, well equipped to serve the needs of the staff in their work, are provided on this floor. The technicians' room, combining a service room with storage and working facilities is used in common by the students and staff. The animal room furnishes enough space to house the temporary requirements for class work besides a few small animals for research purposes.

Two large built-in brine-cooled refrigerators and a closet containing an incubator and a large centrifuge open on the corridor. Next to the professor's office is a room for secretarial work with reprint and other departmental files.

The basement provides for storage rooms, a museum of Chinese drugs, a carpenter's shop, and a manufacturing room equipped with chemical apparatus for preparing large quantities of special drugs.

INSTRUCTION

COURSE 1. PHARMACY

The total absence in China of schools of pharmacy, and the lack of Western pharmacies, make it essential that the Chinese medical student receive some knowledge of the fundamentals of this subject. The practical preparation of many of the common galenicals is supplemented by lectures dealing with Western drug and poison laws, incompatibility, and the art of pharmacy. Posology and the essentials of prescription writing are included in this course.

COURSE 2. MATERIA MEDICA

This is a short course introducing the student to standard reference books and to the properties and tests of a short list of commonly used substances selected from "Useful Drugs," published by the American Medical Association. The lectures aim to give the student the historical background which will enable him to grasp the relative worth of empirical medicine as seen in the practice of old Chinese medicine and of scientific medicine with its outlook especially in chemotherapy.

The laboratory exercises are chemical. They give a knowledge of substances and methods useful in toxicology and in the scientific use of drugs in their relationship to the physicochemical reactions of the body.

Toxicology in China is an undeveloped subject requiring further botanical, bibliographical, and statistical research. Present facts show that there is need on the part of the clinician for a wider knowledge of the identity and symptoms

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of, and of the treatment for, poisoning by common mineral poisons such as arsenic, lead, and mercury salts, and a vast field of Chinese plant poisons, including some well-known substances like opium and the atropine-containing drugs, and many vegetable poisons of an undetermined character. No attempt is made in the student courses to compass this formidable task but the instruction aims to educate the student in the general scientific methods for the recognition of potent principles, so that he obtains a new viewpoint in dealing with the unscientific system of legal medicine now prevailing in China.

The physicochemical reactions of drugs in relation to biological processes have been given in the past quite a minor position in pharmacological instruction. Our schedule includes simple experiments upon chemotaxis, hemolysis, and demonstration of the principles of the digestion, absorption, deposition and excretion of medicinal substances in vitro and in vivo. As far as possible these experiments are undertaken with the more commonly used drugs. With the lessening of the need for pharmaceutical instruction to medical students in China, and with the increasing biochemical knowledge of the action of drugs it is planned to gradually extend this side of the work.

COURSES 3 AND 4. EXPERIMENTAL PHARMACOLOGY

A selected number of classical experiments are performed by the students, and the results obtained are reported upon and discussed in class conferences. One period weekly is devoted to general principles. By the aid of diagrams, slides, etc., the student is given a comprehensive view of the subject. A review of the literature upon the more important drugs is held once a week. This is a seminar in which the students learn to use the library, to abstract scientific articles, to compare results, etc.

RESEARCH

With such a predominance of old-time practitioners in China it is natural that modern medicine should pay some attention to the vast field of Chinese materia medica. The Department of Pharmacology has therefore a unique opportunity for research, and it is hoped that chemical and physiological experiments may show what the many remedies used by native doctors are really worth. At least a few Chinese drugs may prove to be of great value to scientific medicine, and the alleged merits of many of them and the particular manner in which they are administered in certain diseases may be accepted by Western physicians after experimental proof is available.

FIG. 5.—STUDENT LABORATORY

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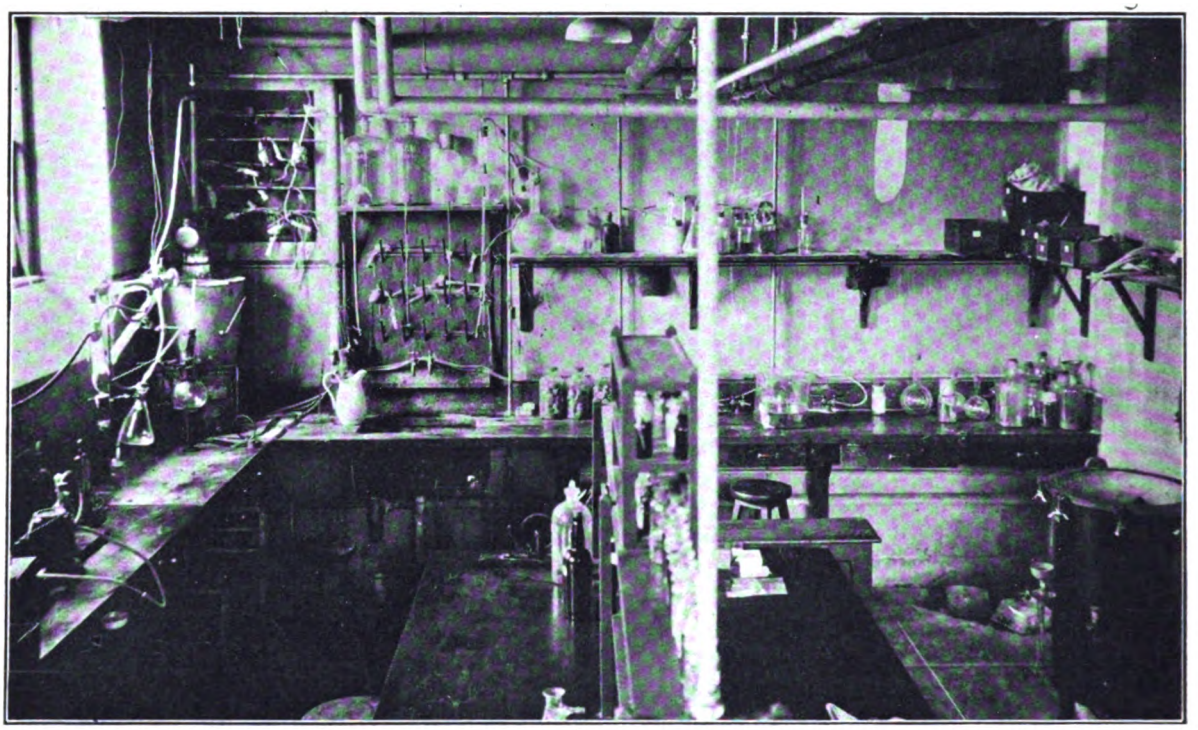

FIG. 6.—SUBDEPARTMENT OF CHEMICAL PRODUCTS, BASEMENT OF "D" BUILDING

CHINESE MATERIA MEDICA

For purposes of research Chinese materia medica may be divided into three groups: (1) Substances official in the European pharmacopoeias, such as nux vomica, opium, alum, corrosive sublimate, rhubarb, and gentian. These drugs have been so exhaustively studied that little attention is paid to them. (2) Drugs which have become obsolete in Occidental practice, and by reason of toxicity or impotency are no longer used in modern medicine. In most cases these have been fully investigated chemically and physiologically, and clinical trial will re-establish their use if they prove to be of value. (3) The remaining drugs, which belong to a large class of unknowns and require botanical, pharmacognostic, chemical, physiological, and pathological studies.

The Chinese Dispensatory contains 1,592 monographs upon substances of animal, mineral, and vegetable origin. The identification of the mineral drugs was undertaken by Dr. Daniel Hanbury in 1860, and a number of other workers have since investigated their relative worth and purity. The animal drugs leave much to be desired. In the light of our limited scientific knowledge and use of animal remedies it is difficult in some cases to understand or try out the fantastic ideas expressed. However, by far the larger number of Chinese drugs are of vegetable origin, which with some exceptions have been identified. The latter therefore offer a good opportunity for research.

The field is so large and the task so complicated that good direction and correlation are necessary. The work is now proceeding along the following lines:

1. Bibliographical work. Original works upon Chinese materia medica are printed in the Chinese language. Not only is it necessary to secure literal translations from one language into the other, but it is also necessary to interpret old Chinese ideas of disease and the fundamental sciences into terms of modern medicine.

Dr. Ralph G. Mills supervised the establishment of a collection of Chinese materia medica at the Severance Union Medical College, Seoul, Korea. This included extensive bibliographical work which forms the basis of our present research. In 1911 Dr. George Stuart published that section of his lifelong studies on Chinese materia medica which deals with vegetable remedies. This book is largely a translation of selected portions of the Chinese "Pen Tsao" with good botanical identifications. There is needed

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much more of this translation work by Chinese who can correlate old and new ideas of medicine. We have secured the co-operation of the Chinese department of the Premedical School of the College in this work.

There is no publication giving a comprehensive view of the modern scientific investigations of Chinese drugs. Effort is being made to bring together in the College library journals containing articles upon Chinese drugs, and assistance is offered to other institutions acquiring such data.

2. Botanical and pharmacognostic studies. Mr. N. Cowdry, who visited the Department in 1921, made the nucleus of a collection of botanical specimens of medicinal plants, which was reported upon in the Proceedings of the Royal Asiatic Society, 1922. In view of our present indefinite knowledge of the origin and character of some Chinese drugs, a continuation of these field studies is desirable. Together with this feature of the work there has been established an experimental garden where, under known standard conditions, medicinal plants may be grown and studied. It is further hoped that this garden may stimulate cultivation, in China, of such valuable drugs as digitalis, belladonna, etc., which are not native to that country. Mr. J. C. Liu, a graduate of the University of Wisconsin, has special training for such work. He will make this subject and pharmacognosy his chief fields of research.

The Severance Collection of materia medica has made a good nucleus for pharmacognostic studies upon Chinese drugs. The size of the country, its poor communications, and its varied dialects, make identification of material a difficult task. Macroscopic and microscopic examination is necessary. There is apparently no satisfactory alternative but to obtain an exact scientific identification of material before chemical and physiological studies can be undertaken.

3. Chemical and physiological investigation. Dr. K. K. Chen has undertaken the chemical extraction of several drugs. His papers on ephedrine and its use in the treatment of Addison's disease promise to be of much value.

Dr. Carl Schmidt's researches upon "Tang Kuei" and other drugs show that Chinese materia medica has a good vista of profitable research on problems which should attract many scientific workers to this field.

Pathology and clinical medicine are so closely connected with various phases of these re-

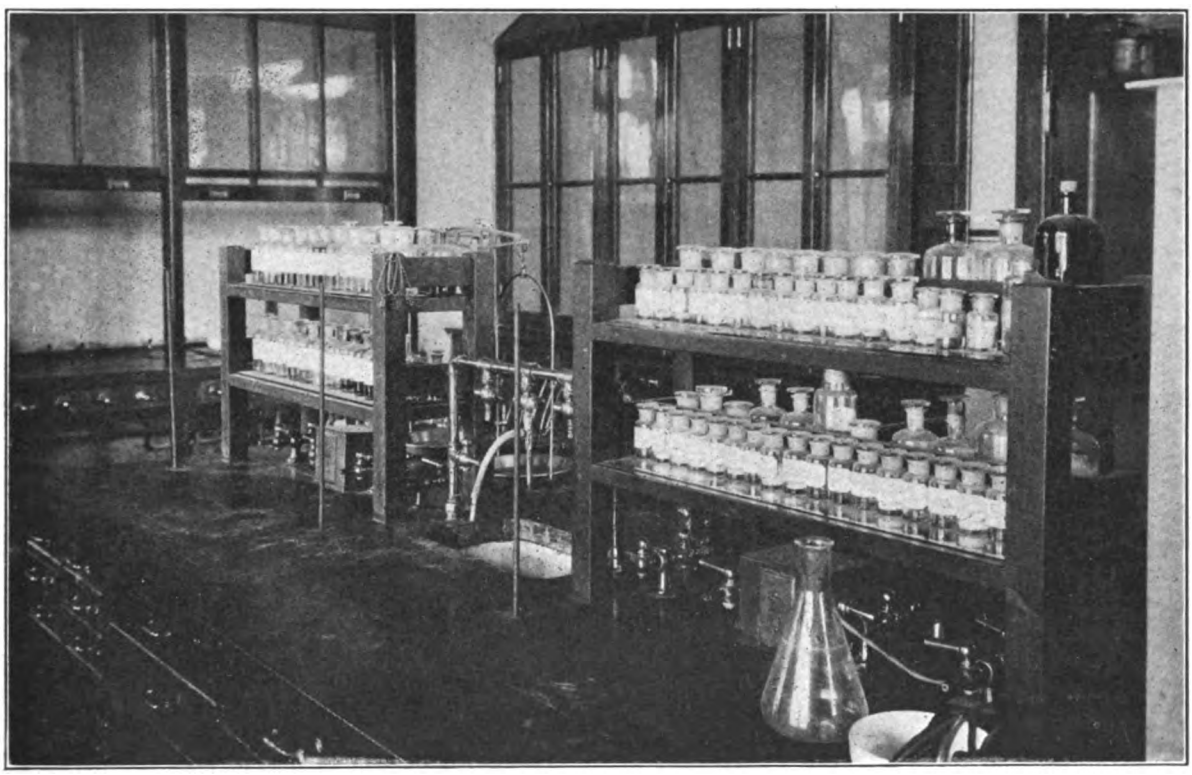

FIG. 7.—PROFESSOR'S RESEARCH LABORATORY

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searches that we hope to secure the co-operation of these and other departments of the College.

A subdepartment of chemical products, now under the supervision of Mr. C. T. Feng, was originally established to prepare the ethyl esters of chaulmoogra oil for distribution in China and Korea to hospitals undertaking the treatment of leprosy. Large quantities of this preparation have been made, and comparative research undertaken with hydnocarpus oil.

Fresh preparations of colloidal antimony for the treatment of kala-azar are made by the special technique necessary for this unstable compound. Absolute alcohol, nitrous oxide, ephedrine alkaloid, and many other elements are produced, depending on the needs not only of the Department but of the whole institution. All products are sold at actual cost, so that this subdepartment involves no expense to the Department of Pharmacology.

STAFF

Professional (All Full-Time)

Associate professor of pharmacology: Bernard E. Read, Ph.D.

Senior assistant: K. K. Chen, Ph.D.

Senior assistant: C. T. Feng.

Junior assistant: J. C. Liu, M.S.

Members of the faculty are granted one year's leave of absence in five which necessitates special provision, not usually required by European schools, for supplementing members of the professional staff.

Technical and Other Assistants

Typist (part-time).

Senior technician trained in chemical analysis and the preparation of charts and conference material.

A general technician in charge of all storage and student apparatus.

Junior technician to assist in all animal experimentation and private research.

Two or more apprentice technicians to the subdepartment of chemical products depending on the output required.

Cleaning and other janitor service is cared for by the general administration of the College.

BUDGET (ESTIMATED) 1924-1925

Salaries of professional staff.....	$14,000
Departmental service	2,446
General expenses	3,500
Total	$19,946

Received for Publication October 21, 1924

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THE MOLTENO INSTITUTE FOR RESEARCH IN PARASITOLOGY UNIVERSITY OF CAMBRIDGE

BY

GEORGE H. F. NUTTALL, M.D., PH.D., SC.D., LL.D., F.R.S., DIRECTOR
QUICK PROFESSOR OF BIOLOGY

DESCRIPTION OF BUILDING

The Molteno Institute for Research in Parasitology was opened in November, 1921. Its building is favorably situated with regard to space and remoteness from the noise, tremor, and dust of street traffic. In the immediate vicinity the Government has erected a low temperature station for the scientific study of refrigeration. The schools of forestry, agriculture, and botany are close by, likewise the physiological and biochemical laboratories. Access to the Downing Site, upon which these buildings stand, is gained from Downing Street, on the opposite side of which lie the medical school, the zoological and chemical laboratories, and other university buildings, including the zoological museum, the Balfour Library (zoological), and the library of the Cambridge Philosophical Society which the workers at the Institute frequently consult. The great University Library is only ten minutes' walk away from the new Institute.

The building is of simple construction. Placed against a background of old trees it represents

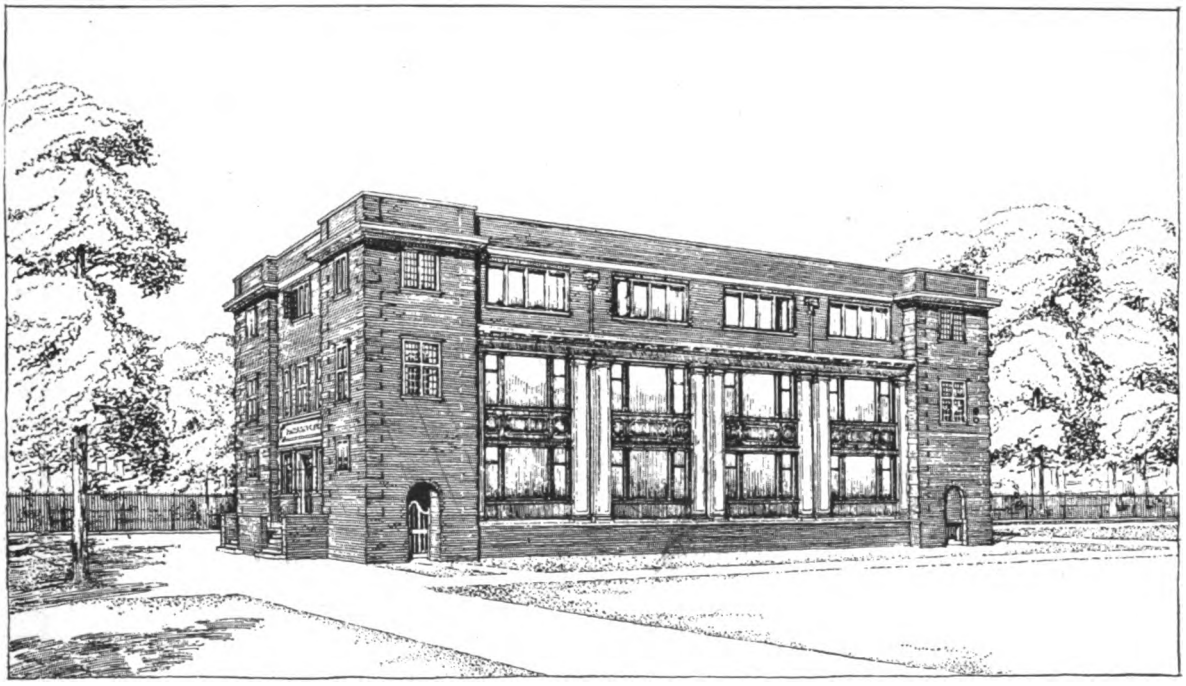

FIG. 1.—GENERAL VIEW OF THE INSTITUTE, NORTH SIDE AND EAST END, SHOWING THE LARGE PLATE GLASS WINDOWS OF THE EIGHT RESEARCH ROOMS ON THE GROUND AND FIRST FLOORS, AND THE FOUR-LIGHT PLATE GLASS WINDOWS OF THE SECOND FLOOR (RESEARCH MUSEUM)

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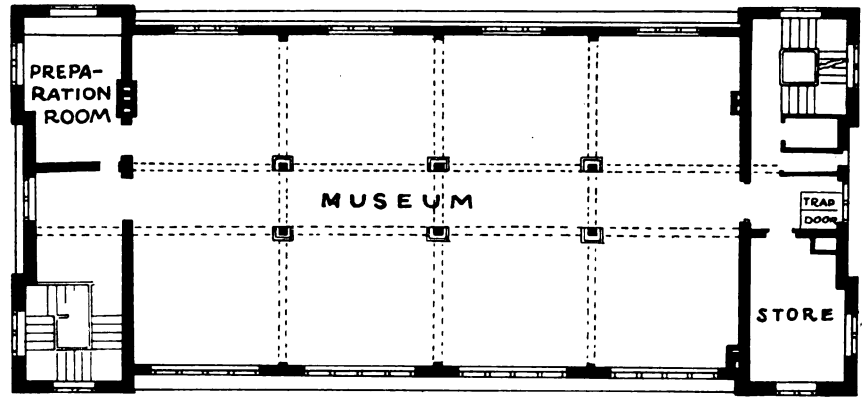
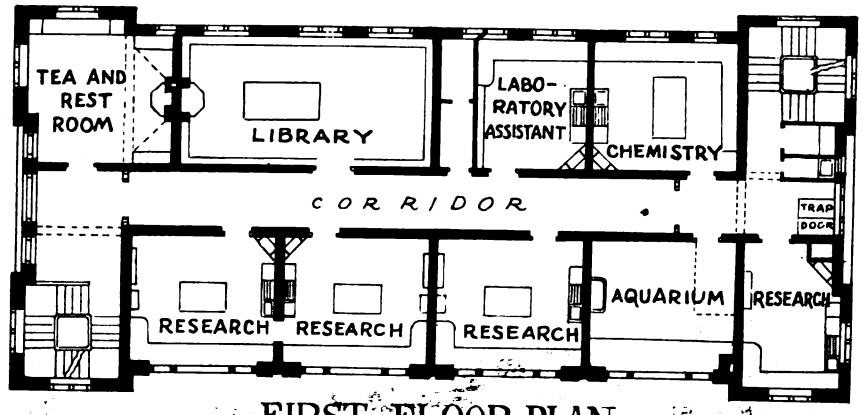
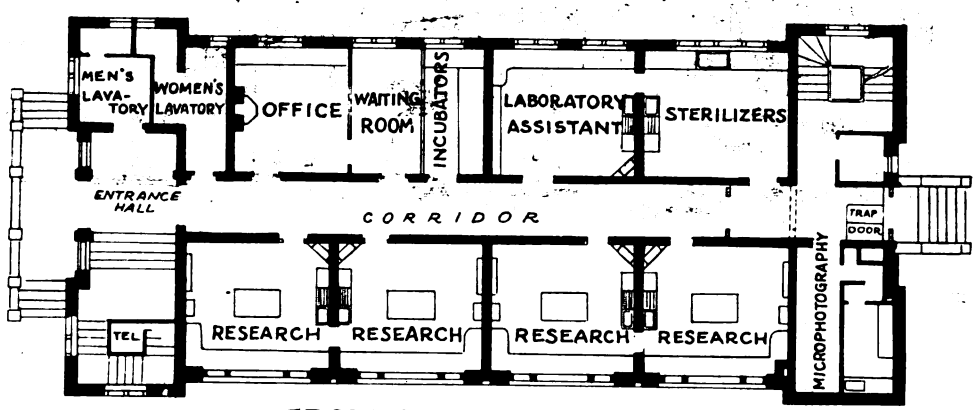
MOLTENO INSTITUTE, UNIVERSITY OF CAMBRIDGE



SECOND FLOOR PLAN



FIRST FLOOR PLAN



GROUND FLOOR PLAN

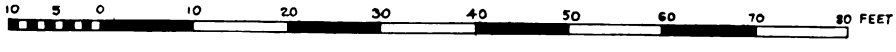


FIG. 2

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an attempt to house a modern scientific department in a manner suited to its needs, and to the atmosphere of its environment. The interior was planned to secure a maximum of convenience in general arrangement, light, ventilation, and heating, having at the same time regard to economy.

Basements are restricted to the ends of the building, and serve on one end chiefly for bicycle storage, and on the other as a location for the heating plant, a small animal room, and storage space.

waiting room, and lavatories and cloakrooms for male and female students.

The first floor has four research rooms and an aquarium on the north side. The south side has a library, a lavatory, a laboratory assistant's room, and a chemical room, as well as a tea and restroom. The latter is useful as a gathering place for sociable intercourse among the workers at the Institute during the short interval when tea is provided, as a place where one can bring a meal when desired, and as a room where workers may rest or even spend the night, should

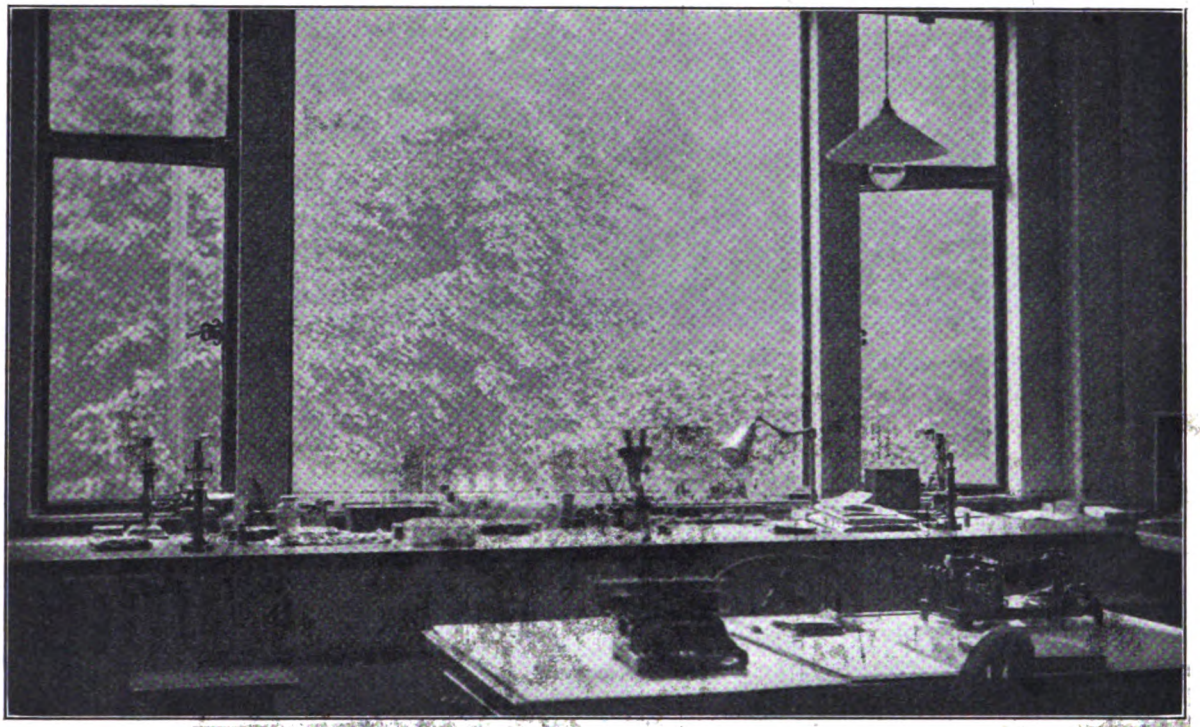

FIG. 3.—A GROUND-FLOOR RESEARCH ROOM SHOWING LARGE WINDOWS LIGHTING BENCH CARRIED ON T IRONS FIXED IN WALL. RADIATOR BENEATH TO LEFT WITH GRATING ABOVE IT IN BENCH

Entrances are provided at both ends. Straight corridors, running midway along the length of the building on the ground floor and the first floor, are lighted through transoms at the sides and through glazed panels in the doors which cut off the vestibules at each end. In the western vestibules on three floors there are hoist holes with trapdoors through which heavy articles can be raised from the basement by chain and pulley. This functions in place of an elevator and does not limit floor space when not in use.

The ground floor has five research rooms, sterilizing and microphotographic rooms, an office, this be necessary in connection with researches which require periodic observations. The room has nothing reminiscent of a laboratory about it. Comfortable chairs, a fireplace, and a long cushioned bench, which can be converted into a sleeping place, are some of the conveniences provided.

The second floor is almost entirely devoted to the research museum whose north side may serve for demonstrations, practical instruction, or for research work, and, if necessary, can be divided up by movable partitions to form cubicles. Museum cases, cabinets, and various cupboards

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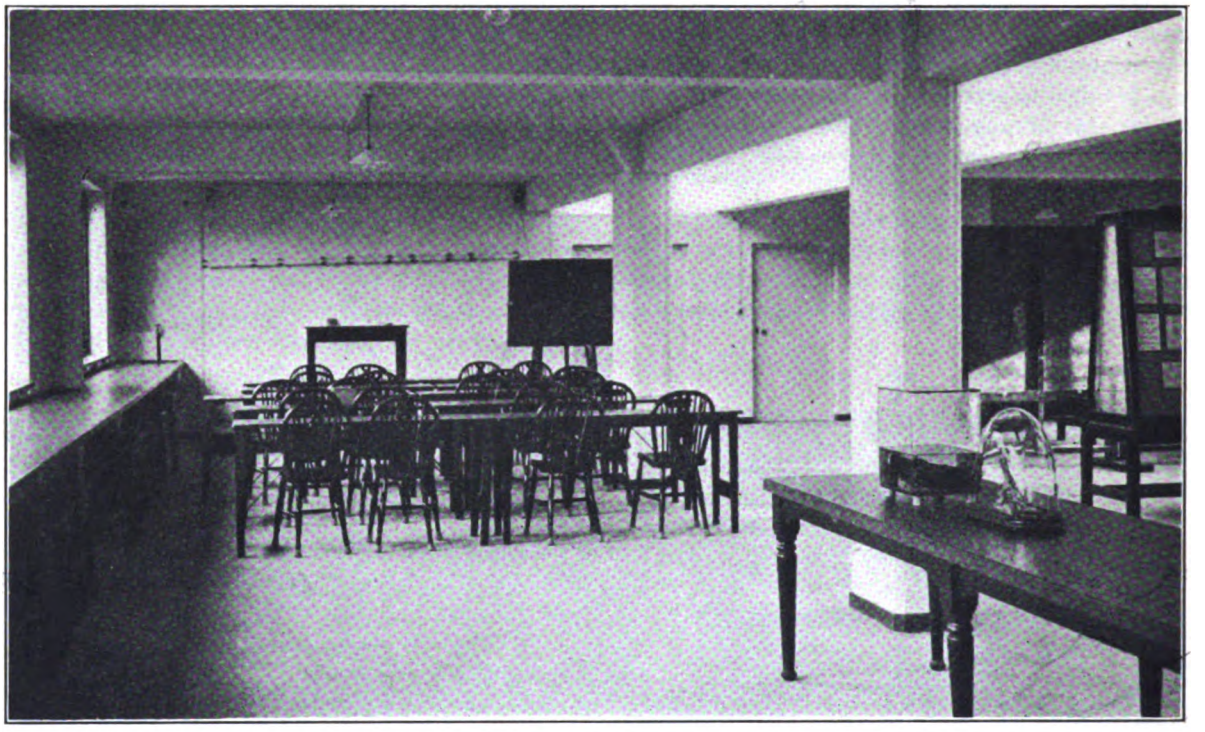

FIG. 4.—RESEARCH MUSEUM ON TOP FLOOR, WITH LONG BENCH ON NORTH SIDE, HAVING SINKS AT ENDS. THIS SIDE IS USED FOR LECTURES AND DEMONSTRATIONS. MUSEUM CASES ON SOUTH SIDE. DOUBLE SKYLIGHT ALONG WHOLE LENGTH

FIG. 5.—PARASITOLOGICAL LIBRARY. WOODWORK OF TEAK

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FIG. 6.—TEA AND RESTROOM WITH SPECIAL HIDDEN SINK, ETC., BUT NOTHING REMINISCENT OF A LABORATORY

occupy the south side. A preparation room opens into the museum at one end, while the north-west corner of the building contains a store-room.

The building is heated by hot water on the low-pressure system, with provision for the introduction of gas stoves if required. Ventilation is secured by opening windows, transoms, or borrowed lights, and by allowing air to enter from the outside through apertures near the radiators.

EQUIPMENT

The Institute is well provided with all apparatus and modern appliances for the study of the biology of parasites. Special attention is being given to securing facilities for the study of the best and most recent methods of conducting research in parasitology.

The collections are intended primarily to aid the workers at the Institute and are housed in the research museum, the latter affording space for the considerable expansion which is expected in the future. The Nuttall collection of Ixodoidea is the most valuable at present, and besides being rich in types, is one of the largest existing. There are many specimens of blood-sucking and parasitic insects and acari. The helminthological collection is rapidly growing in value, and, like the preceding, comprises types. Protozoological and mycological specimens are being steadily acquired, and there is a bacteriological cabinet. It is hoped that the collections will be augmented by means of exchanges and through the further generosity of donors in different parts of the world. A considerable amount of illustrative material, largely original, including diagrams prepared for the purpose of instruction in parasitology, is already contained in the museum.

The basis of a departmental library has been formed by the gift to the Institute of the whole of the writer's scientific books, brochures, reports, journals, and some thousands of reprints.

INSTRUCTION

The Institute was founded for the advancement of knowledge of parasitology in all its branches, being in this respect the first of its kind. Hitherto parasitology has been taught in a limited way in professional schools, either medical or veterinary, in zoological and botanical laboratories, or in conjunction with agriculture and fisheries;

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consequently the student has been precluded from obtaining a general survey of the subject as a science. Similarly, in the matter of research, the work carried on in the various schools has been largely confined to problems having only a practical professional bearing. The Molteno Institute proposes to deal with parasitology on a broad biological basis, the research and instruction offered therein being directed both to purely scientific and to practical problems because pure and applied science are inseparably interwoven and many of the most important practical discoveries in the past have had their origin in purely scientific investigation.

At present the teaching is being reorganized in respect to parasitology. Although taught in a separate department, it is treated in relation to pathology and preventive medicine, and will form part of the medical curriculum and teaching in pathology. The course is being extended, and will consist of lectures followed by practical work on two days in the week.

RESEARCH

The research at present concerns the structure and biology of parasites affecting man and animals. The particular organisms being investigated are protozoa, helminths, and arthropods. One student is at work on mycology. Suspected parasitological material is periodically sent to the Institute for examination and report to the hospital and to practitioners.

STAFF

The professional staff consists of a professor, a demonstrator, and an assistant to the Quick professor. There are no practitioners of medicine upon the staff. All members are occupied with research coupled with a moderate amount of teaching.

The service consists of a secretary, an artist, a chief laboratory assistant, a laboratory boy, and a man who does the cleaning.

EXPENDITURES

The following statement covers the expenditures for a nine months' period (October 1, 1922, to July 31, 1923), the figures for a complete year not being available on account of a change in the date for the ending of the financial year.

General expenditures	£547. 3. 7
Salary of staff and fees	319. 2. 0
Wages for service	707.10. 6
Research (chemicals and apparatus)	71. 7.11
	£1,645. 4. 0

Received for Publication April 5, 1924

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THE OBSTETRICAL AND GYNAECOLOGICAL UNIT
LONDON (ROYAL FREE HOSPITAL) SCHOOL
OF
MEDICINE FOR WOMEN (UNIVERSITY OF LONDON)

BY

A. LOUISE MCILROY, M.D., D.Sc., DIRECTOR
PROFESSOR OF OBSTETRICS AND GYNAECOLOGY

The Obstetrical and Gynaecological Unit at the Royal Free Hospital, Gray's Inn Road, London, was established in February, 1921, as part of the new organization to improve the teaching of medicine and surgery in Great Britain. Like other units formed under this scheme at the London hospitals having medical schools this Unit is affiliated to the University of London and receives an annual grant from the University Grants Committee appointed by His Majesty's Treasury.

The Medical School of the Royal Free Hospital is known as the London School of Medicine for Women. The Dean is Dame Louisa Aldrich-Blake, D.B.E., M.D., M.S. All of the students at the Royal Free Hospital are women who have received their training in biology, chemistry, anatomy, and physiology in the London School of Medicine for Women which also provides training in the subjects for women students desiring to complete their training at other hospitals.

For many years before the Unit was established special attention had been devoted to obstetrics and gynaecology. From 1908 to 1919 these departments were mainly controlled by Lady Barrett, C.B.E., M.D., M.S., a member of the Honorary Visiting Staff of the Royal Free Hospital to whom is due the credit for creating the organization on which the Unit was founded. The Director of the Unit being prohibited from private practice, Lady Barrett found it impossible to accept the position. Miss A. Louise McIlroy, M.D., D.Sc. (Glasgow), was appointed first director of the Unit and professor of obstetrics and gynaecology for five years. The Royal Free Hospital has raised a fund to build and equip new wards and a new nurses' home. The buildings are approaching completion.

Reference must be made to the valuable assistance of Sir George Newman, K.C.B., M.D., R.R.C.P., chief medical officer of the Ministry of Health who at an early date recognized the necessity for special facilities for teaching obstetrics and gynaecology in a medical school devoted entirely to the training of women. This was the chief reason why the Royal Free Hospital was selected as the home of the Obstetrical and Gynaecological Unit.

Skilled treatment is provided for pregnant women and gynaecological cases in the Unit. The following schedule describes the Unit, its personnel, work, scheme of teaching, and finance in more detail.

ACCOMMODATION DEVOTED TO THE WORK OF THE UNIT

1. Forty-eight maternity beds;[1]—33 lying-in beds and cots in three wards; 6 V. D. maternity beds and cots in separate ward; 4 isolation beds and cots in separate ward; 5 labour beds.

2. Twenty-three gynaecological beds[1] in ward divided into two parts.

3. One theatre fully equipped for use of Unit only. Use of two other theatres for gynaecological operations.

4. Out-patient department, with professor's room, assistant's room, examination rooms, and use of out-patients' waiting-hall.

5. Residence accommodation specially provided for three resident obstetric officers and twelve midwifery clerks.

[1] All beds are available for teaching purposes.

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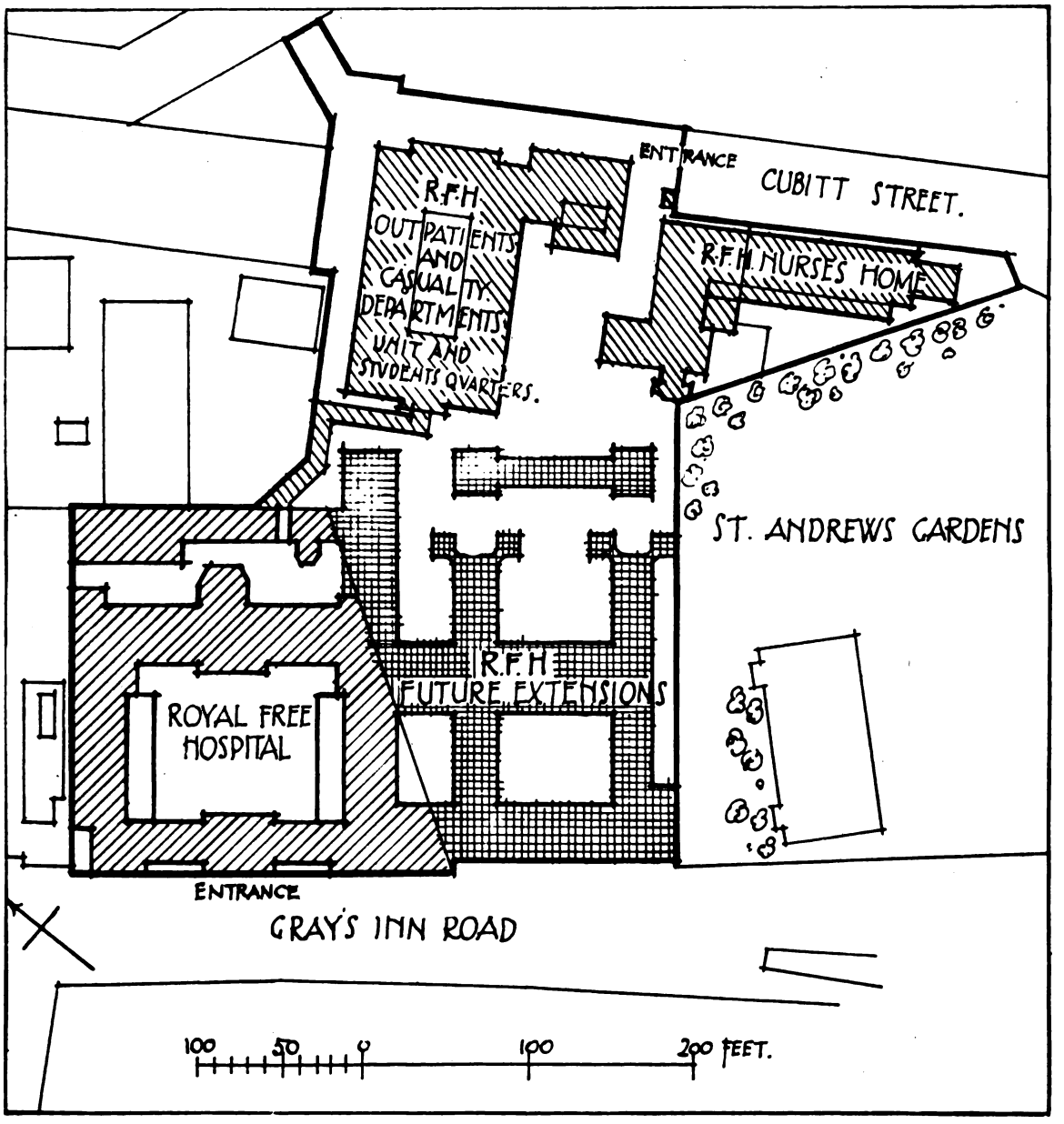

FIG. 1

6. Pathological laboratory with research rooms for Unit only.

7. Professor's and assistant's rooms, with clerk's room, cloakroom, bathroom, etc.

8. Examination rooms adjoining (i) maternity, (ii) gynaecological wards, fitted up for teaching. Special teaching on the case is given after it has been examined by the staff and students, and has been returned to the ward.

9. Interview room for patients' friends.

10 and 11. Demonstration room for students, equipped with obstetrical models of all kinds, in close proximity to a lecture theatre equipped with epidiascope.

12. Use of animal house and research laboratories in connection therewith, specially maintained in the medical school for members of the staff holding certificates from the home office for animal experimentation.

13. The pathological museum of the Hospital contains an obstetrical and gynaecological section. These specimens, together with the notes

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of all cases in the Unit, are under the charge of the obstetrical and gynaecological registrar, who is a member of the staff of the Pathological Department.

14. Sisters' and service rooms as required for an efficient nursing service in connection with the Unit.

15. Maternity district in the four boroughs of St. Pancras, Islington, Holborn, and Finsbury.

SCHEME OF PRACTICAL WORK AND TEACHING

The course of instruction given to the students is as follows:

1. *Midwifery clerkship.* Every student receives instruction in the Unit and attends for two months for this purpose.

First month. Spent wholly in the wards under direct supervision and instruction. Students use gloves for all deliveries. The Director makes a

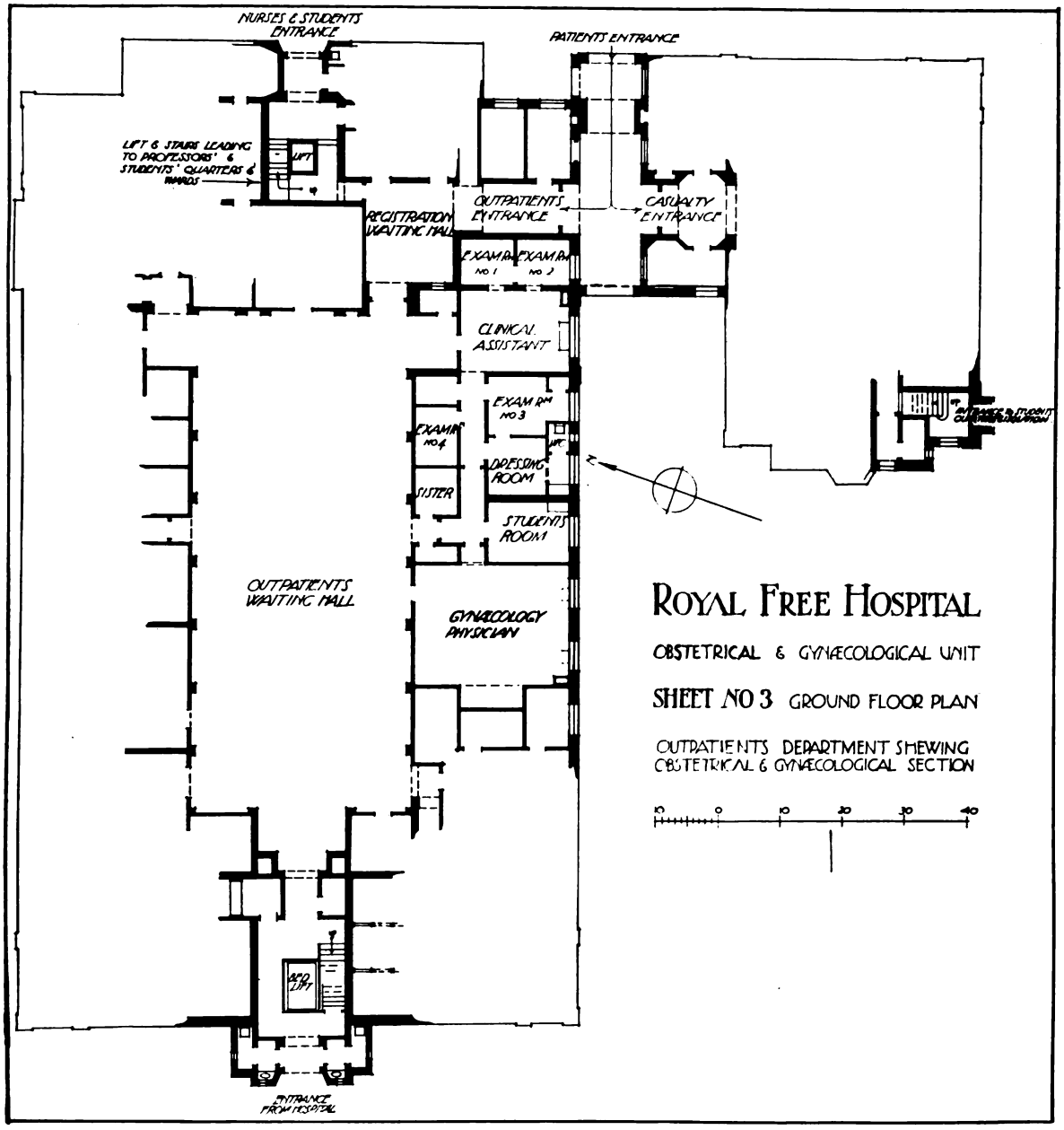

FIG. 2

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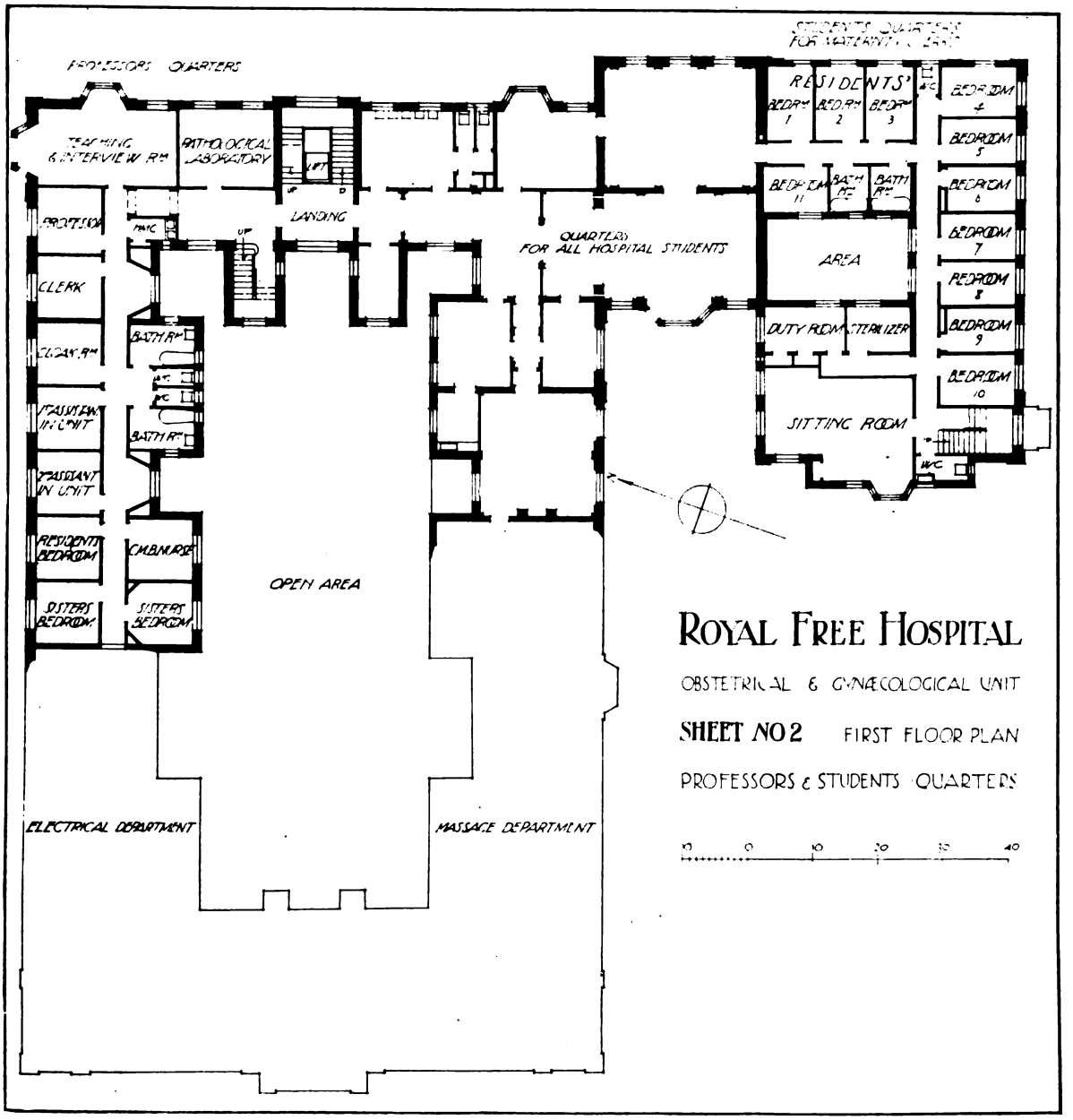

FIG. 3

round of all the maternity beds once a week with the students and gives a demonstration on selected cases also once a week. Daily ward clinics are given by the Director and the assistants on the cases that each has under her charge and students on midwifery duty have access to the wards at any time.

Second month. Spent mainly attending midwifery cases in the district surrounding the Hospital. Students usually go in pairs. They use gloves and take sterilised equipment with them. The district obstetric officer supervises every case; but if the confinement is normal each student takes definite responsibility for her own case, the preliminary teaching in the Hospital having sufficiently fitted her to do this. Each student keeps records of her cases, and reports them to the district obstetric officer.

2. *Gynaecological clerkship for three months.* About half the students of the school hold these clerkships in the Unit. The remaining students hold them (i) under Dr. Ethel Vaughan-Sawyer,

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gynaecologist to the Hospital outside the Unit, with charge of ten beds, and (ii) under Dame Louisa Aldrich-Blake or Miss Elizabeth Bolton, M.D., B.S., surgeons and gynaecologists to the Elizabeth Garrett Anderson Hospital (72 beds), which is associated with the medical school and recognised by the University of London for the teaching of gynaecology.

3. *Preliminary demonstrations on midwifery.* Six lessons given three times a year by Director and assistants.

4. *Course of lectures* given by the Director, and dealing with special subjects in gynaecology and midwifery. Autumn and spring terms, once a week.

5. *Four tutorial classes* held once a week, four times a year, by assistants.

6. *Course in operative midwifery* given by the Director. Six sessions, four times a year.

7. *Antenatal clinics* four times a week. Two months.

The notes made at these clinics are available when the case comes into the wards or is treated in the district.

8. *Postnatal clinic* once a week for patients who are asked to attend one month after delivery. Two months.

Babies on leaving the charge of the Unit have a card giving weight and method of feeding, and are thus passed on and taken into the infant welfare department, under the care of an assistant physician of the hospital.

9. *Infant consultations* (i) consultative and (ii) treatment, held by one of the physicians of the Royal Free Hospital. Six weeks.

10. *Venereal diseases clinic,* under the care of a specialist in the subject. Every student attends twenty.

Thus the students give the whole of their time for five months to the study of obstetrics and gynaecology. In addition, the lectures and classes on obstetrics and gynaecology and attendance at venereal clinics may extend over a much longer period.

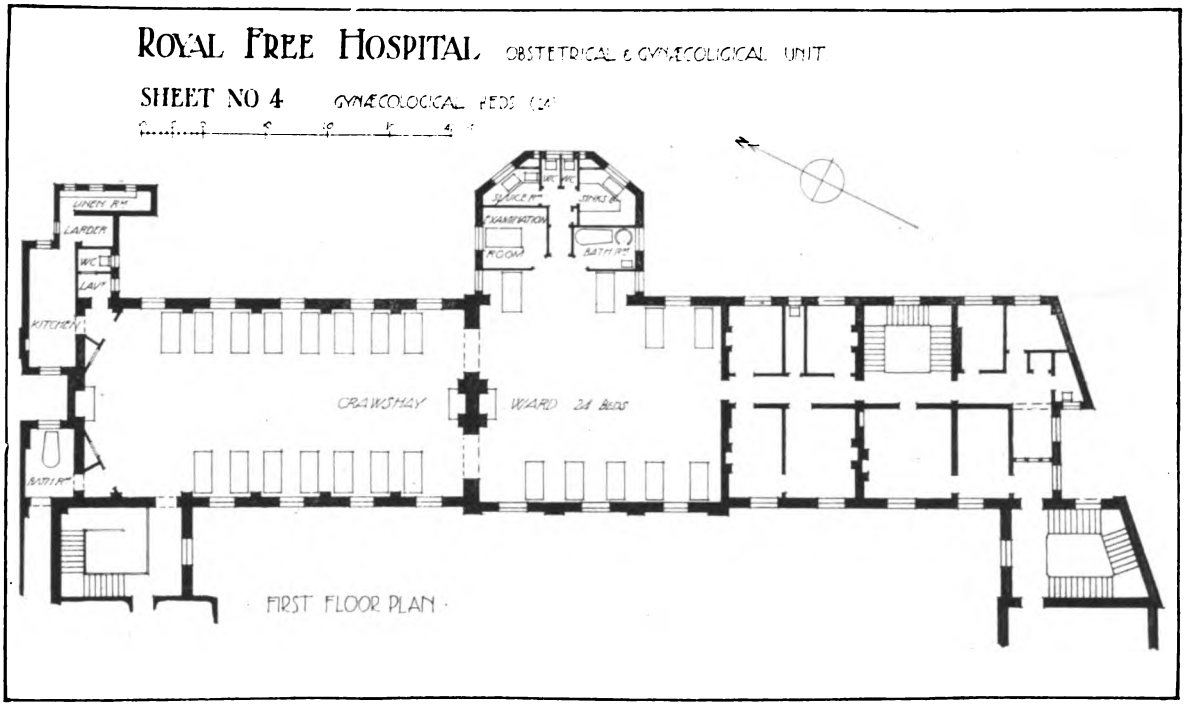

FIG. 4

PERSONNEL AND DUTIES

The Director, Miss A. Louise McIlroy, who is also professor and examiner of obstetrics and gynaecology in the University of London, is a full-time officer. Salary £2,000 per annum, with 10 per cent addition under the superannuation scheme. Has full responsibility for the Unit: (1) the organization of the teaching which is arranged to comply with the requirements of the University of London, and other examining bodies, (2) the treatment of the patients in the

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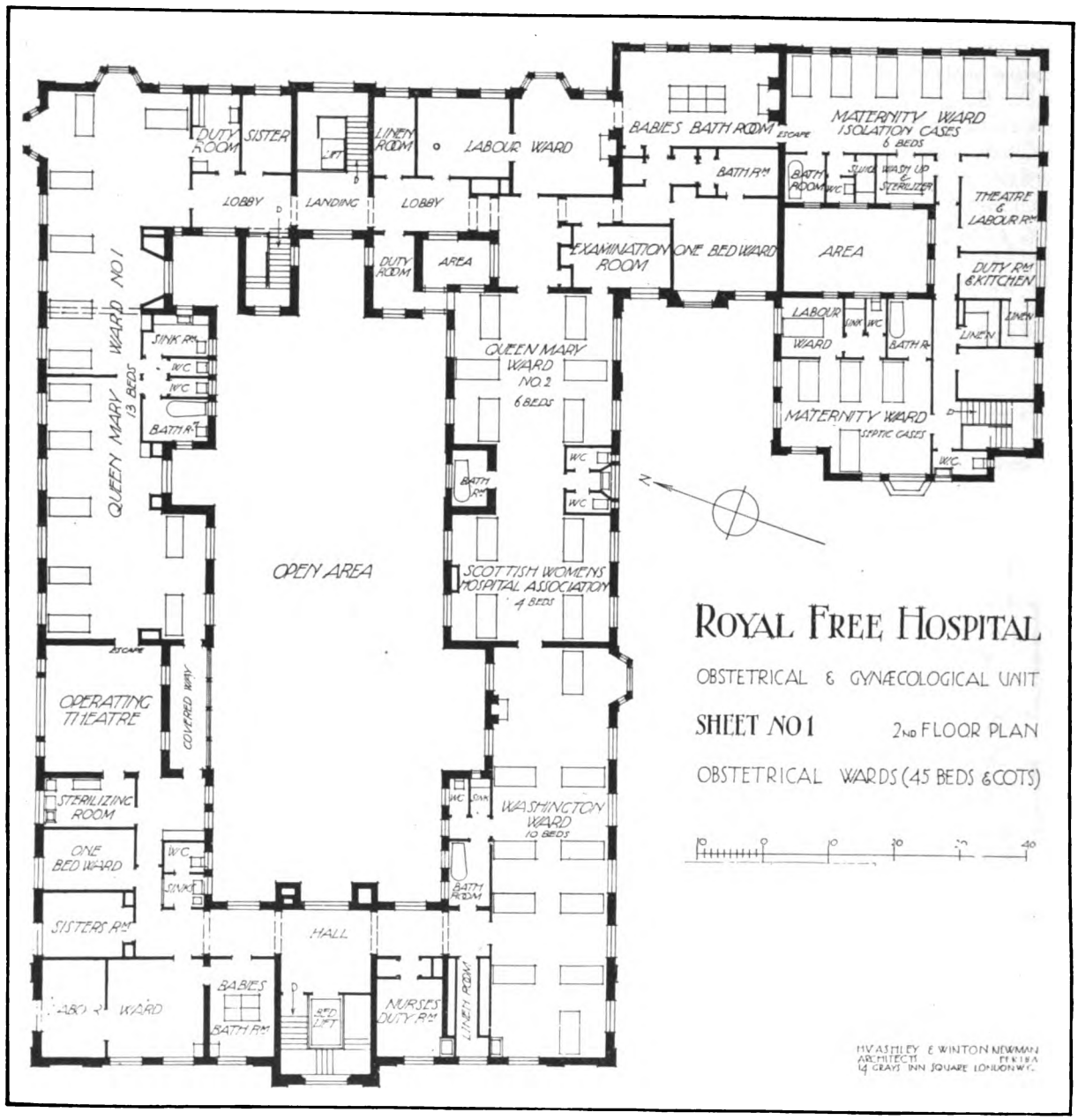

FIG. 5

wards, out-patient departments, and midwifery district, and (3) the direction of research investigations. The Director visits all in-patients in the Unit once a week, and also keeps under her direct personal supervision certain of the maternity and gynaecological beds, delegating responsibility to the first and second assistants as she thinks desirable. The Director attends regularly in the Out-patient Department on one afternoon a week to see maternity cases after their discharge from wards, or after delivery in the district, and gynaecological cases referred to her by outside practitioners. She also attends an antenatal clinic once a week.

First assistant: Miss Gertrude Dearnley, M.D., B.S. (Lond.). Salary £250 per annum, with 10 per cent superannuation allowance. Full-time officer; no private practice allowed.

Second assistant: Miss Edith M. Hall, M.D., B.S. (Lond.). Salary £500 per annum, with 10 per cent superannuation allowance. Full-time officer; no private practice allowed.

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FIG. 6.—ENTRANCE TO THE OBSTETRICAL AND GYNAECOLOGICAL UNIT

The two assistants are responsible in alternate weeks for the supervision and teaching on all maternity cases admitted to the wards, except those under the direct care of the professor. They also take charge of a certain number of the gynaecological beds allotted to them by the professor. They undertake out-patient and antenatal clinics, and are on call for emergencies in the maternity district.

Lately a whole-time third assistant or obstetric resident tutor has been added who supervises the work of the students and teaches in the labour wards on normal and abnormal cases. This post is held by Miss Haggett, M.B., B.S., at a salary of £250 per annum.

The obstetrical and gynaecological registrar: Miss Salmond, M.B., B.S. (Lond.). Salary £250 per annum. Full-time officer. Part of the time of this officer is devoted to the care of the records in the Obstetrical and Gynaecological Department, and part to the pathological investigations for the Department, and the supervision of the clinical pathology carried on by the students attached to the posts. The system of having a somewhat senior whole-time officer, who is responsible for the students' case notes, and for a certain amount of the pathological teaching is also carried out in the Department of Medicine and Surgery. The obstetrical and gynaecological registrar is also available for replacing the first or second assistant in respect to their clinical duties should occasion arise.

None of the above is resident in the Hospital, though all are required to live near by, and to be in telephonic communication in order that they may readily be summoned for emergency work.

Three junior resident officers have charge as

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FIG. 7.—WASHINGTON MATERNITY WARD

follows: (1) obstetric house surgeon, attached to the gynaecological beds and to the Washington maternity ward; (2) obstetric assistant, attached to the remaining thirty-four maternity beds, and (3) district obstetric officer, whose main duty is to take out students to their early cases in the district, and to be on call for emergency district work. All these officers live at the Hospital, and devote their whole time to the care of the patients, under the direction of the professor and assistants. Each officer has her own duties in the out-patient and antenatal and postnatal clinics. The term of appointment for each is four months.

The Medical Research Council (set up by the State under the National Insurance Act) makes special grants (1) for special research work by Dr. Christine Williams and two assistants on "The Toxaemias of Pregnancy"; (2) For a trained laboratory assistant to the professor. The Council also pays the expenses of the necessary laboratory material required for these investigations.

Two research fellows for the professor were appointed in October, 1924, for whose salaries provision has been made by a friend of the School. These fellows were appointed for one year in the first instance with renewal of appointment if considered desirable. The investigations to be carried out are: (1) the study of heart conditions in pregnancy; an electrocardiograph has been presented to the Hospital by the same donor for the purposes of this investigation; (2) the causes of antenatal and neonatal deaths.

RESEARCH

1. Director. Among other subjects, (i) research regarding (*a*) position of the foetus in later weeks of pregnancy; (*b*) changes in the polarity of the foetus, and (*c*) localisation of the foetal heart by auscultation and X-rays. (ii) "An inquiry into the causes of loss of weight in the new born."

2. First assistant: Miss Dearnley, M.D. An examination of antenatal cases with regard to pelvic measurements.

3. Second assistant: Miss Hall, M.D. Research regarding the measurements of the pelvis during pregnancy, labour, and the puerperium.

4. Director, and assistant physicians of the Hospital, Dr. Dorothy Hare and Dr. Hoskin. (i) Researches into the changes which occur in the heart during pregnancy, and the effect of the latter upon cardiac lesions. (ii) Researches into the action of pituitary extract in labour and its induction.

5. Staff, in combination with Mrs. Williams,

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M.B., B.S., from the Physiological Department. (i) The toxaemias of pregnancy. (ii) The chemical analysis of the blood and urine is carried out in a large number of cases normal and abnormal.

6. Director and Miss Dundee, M.B. An investigation into the industrial factors which affect (i) dysmenorrhoea and (ii) pregnancy. This research entails an investigation of factory conditions, and facilities have been given by a large number of firms employing women workers. The object of the research is an inquiry into the incidence of dysmenorrhoea and it influences, with a view to elucidate its causation.

7. The Director, Miss Gourlay, M.B., B.S., and Miss Leverkus, M.B., B.S. Research upon the effect of ultra-violet light in inflammatory affections of the uterus.

COLLABORATION

1. The investigation of pathological specimens is carried out in the Unit laboratory and also by the staff of the Pathological Department.

2. There is a close collaboration with the Vehereal Diseases Department more especially in the obstetrical section. The physician for venereal diseases, Dr. Margaret Rorke, undertakes the treatment of patients in the V. D. obstetric wards, the Unit staff being responsible for the obstetrical treatment.

3. The Infant Welfare Department, under Dr. Chodak Gregory, assistant physician of the Hospital, works in collaboration with the Unit and the infants on leaving are brought to the welfare clinic.

4. An investigation into the quality of human milk is being carried out with the Physiological Department (Professor Winifred Cullis).

5. Stillbirths are investigated as a routine by Dr. Lucas Keene (Anatomical Department).

FINANCE

The London (Royal Free Hospital) School of Medicine for Women maintains the entire teaching staff of the Unit out of funds available for education. The figures here given are for 1922-1923:

General maintenance	£110
Salaries, professorial staff.....	3,700
Wages, technical staff.....	210
Research material	25
Total	£4,045

The Royal Free Hospital meets the following

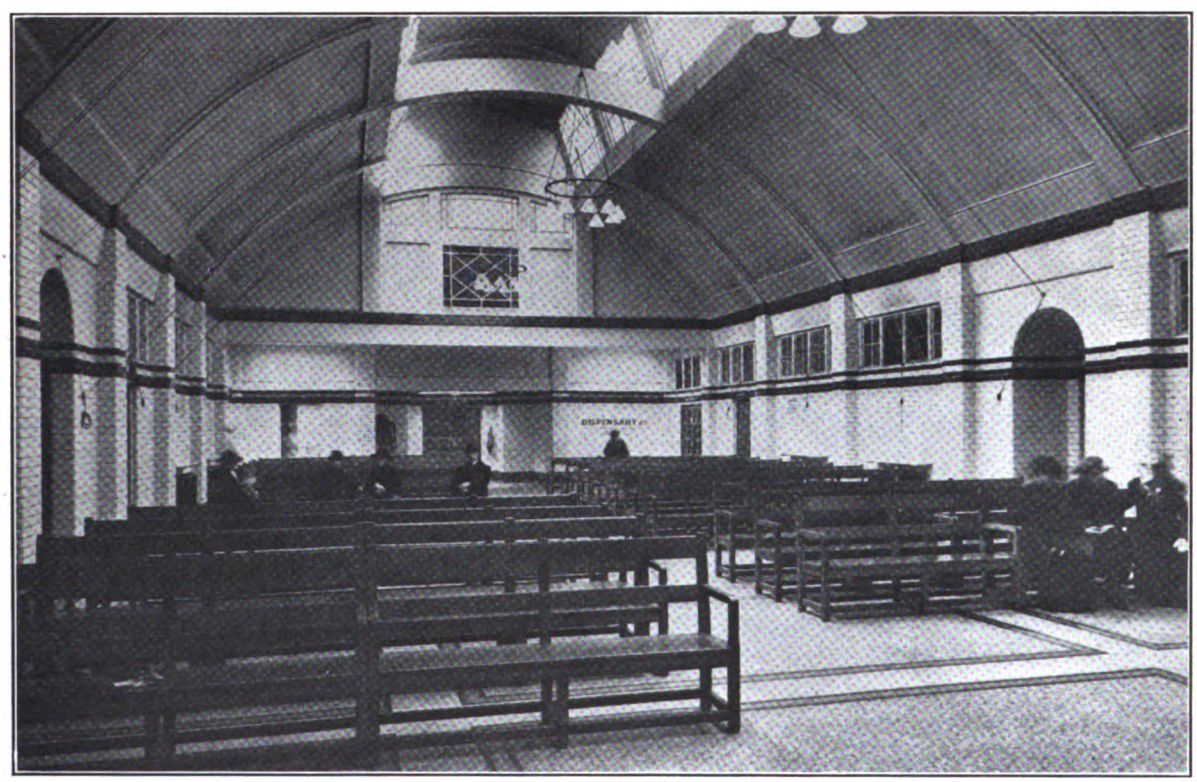

FIG. 8.—OUT-PATIENTS' DEPARTMENT

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charges: Maintenance of 68 beds; nursing service; resident medical officers' salaries and maintenance; part of salary of registrar; all overhead charges; Out-patient Department; almoners; health visitors.

The School and the Hospital jointly maintain the Pathological Department of the Hospital, the services of which are available for the Unit.

RELATIONS TO OTHER BODIES

The School is a constituent college of the University of London in the Faculty of Medicine. The twelve medical schools included in the Faculty of Medicine in the University of London are independent bodies, and have no direct relation to one another, but lectures in special subjects are given in the different clinics from time to time, to which advanced students are admitted from all schools. The University examinations in all faculties are the same for all schools. The school is in receipt of an annual grant from the University Grants Committee, which is a committee of H. M. Treasury.

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PEKING UNION MEDICAL COLLEGE DEPARTMENT OF BIOCHEMISTRY

BY

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BUILDING

The Department of Biochemistry occupies the second floor (46 ft. by 135 ft.) of the so-called "C" Building which is the main building of the College group. The first floor is used for the library and the office of the Director. The third floor is reserved for the future use of the Department but at present provides living quarters for the male nurses of the hospital.

The longer axis of the building runs east and west. At the east end of the floor is the students' laboratory (46 ft. by 48 ft.), containing twenty-two desks, and equipped with a balance room, an optical room, a Kjeldahl room, a warm room, a supply room, and a refrigerator. The warm room is electrically heated and the refrigerator is cooled by cold brine from the power house. The laboratory has windows on three sides, admitting plenty of light for work. Each desk has access to an electrical socket, is fitted with gas, compressed air, hot and cold water, and steam, and is provided with a shelf of common reagents and a small sink. Besides the desks there are wall benches for microscopes and colorimeters which the students use in common. Two of the steam radiators which have horizontally arranged pipes are covered with cases of galvanized iron and a metal plate is placed on top of each layer of pipes, thus providing shelves for drying purposes. A steam bath containing twenty-four

FIG. 1.—CHEMISTRY BUILDING

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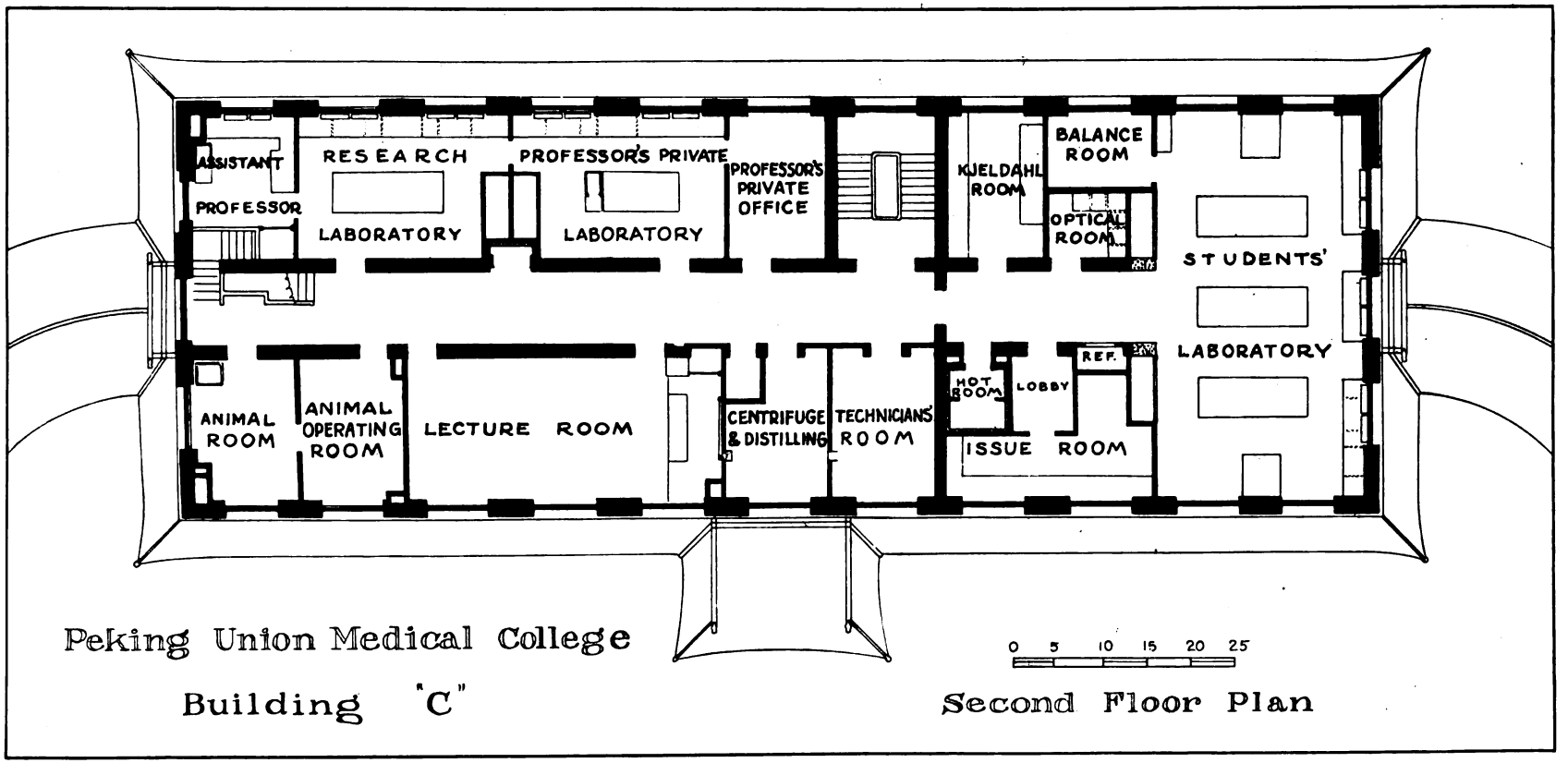

FIG. 2

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holes is also provided and a shower bath which can be used for putting out fire on clothing.

The floor is divided in the middle by a corridor which runs west from the students' laboratory. Next to the students' laboratory on the south side is a work room (11 ft. by 16 ft.) for the technicians, which contains a bench and is provided with gas, water, and electricity. Adjoining is the centrifuge and distilling room (11 ft. by 16 ft.) equipped with four distilling batteries, arranged for six distillations each, and three centrifuges, the largest of which can handle four bottles of 250 cc. Then comes the lecture room (34 ft. by 16 ft.) with seating capacity for thirty students. The windows of this room are provided with light-tight screens, and the wall behind the blackboard is painted with aluminum to receive lantern projections. Next to this is the animal operation room (25 ft. by 16 ft.) provided with a steam sterilizer, an operating table, and a glass case for surgical instruments, etc.

On the north side of the floor and nearest to the students' laboratory is the professor's office (10 ft. by 16 ft.), with a private laboratory (23 ft. by 16 ft.) adjoining. Next to this is a similar laboratory (23 ft. by 16 ft.) used by the assistant and graduate students. Finally, on the west end of the floor is the assistant's office (10 ft. by 16 ft.) which is also equipped for laboratory work.

The lecture room and the laboratories are provided with hoods, the draft being supplied by two fans placed in the attic of the building. All the rooms have cement floors except the professor's office which has an oak floor, and the animal operation room which, like the corridor, is of terrazzo.

The Department has a storeroom for apparatus and one for chemicals in the basement.

The third story of the building, although not used at present by the Department, has all the requisite plumbing and wiring and can easily be converted into chemical laboratories. It is hoped that eventually a students' laboratory with fifty desks and a room for physicochemical measurements, as well as a private laboratory and an office for a member of the staff, will be fitted up here. When this is done the present students' laboratory will be released for the use of food investigation and for graduate work.

FIG. 3.—STUDENTS' LABORATORY

TEACHING METHODS

Due to the traditional method of education, Chinese students are apt to content themselves with mere memorizing. To counteract this ten-

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FIG. 4.—PROFESSOR'S PRIVATE LABORATORY

dency it has seemed desirable to emphasize original thinking. It is more important, therefore, to teach them how a conclusion is reached than the conclusion itself. Of the preclinical subjects biochemistry seems best adapted for the teaching of scientific methods of inquiry, and we make it a practice to introduce problems, whenever possible, for the students to solve after a brief discussion of the pertinent data or the principles involved. For example, instead of telling them what is believed to be the structural formula of yeast nucleic acid, the students are required to draw their own conclusion from the facts presented to them about it. At the beginning of each lecture hour a ten-minute quiz is given or a discussion held to help the students to grasp the more important points of the preceding lecture.

RESEARCH

There being no clinical duties, the staff members devote all their time to teaching and research. The time is about equally divided between the two. For the past few years the research activity of the Department has centered around the chemistry of blood, analytical, clinical, and physicochemical. At present the study of serum proteins occupies our attention. Another line of work which has been started is the investigation of Chinese foods, and it is hoped that an extensive study of their biological value and vitamine contents will be made in the near future.

STAFF

The professional staff for the year 1924-1925 consists of Hsien Wu, Ph.D., associate professor of biochemistry, Kuo-hao Lin, Ph.D., and Daisy Yen, M.A., assistants.

Three technicians, one typist on half time, and one coolie were employed. An assistant to work exclusively on Chinese foods will probably be appointed in the future.

BUDGET

The estimated expenditure of the Department for the year 1924-1925 is as follows:

Salaries of professional staff	Mex. $11,475
Salaries of non-professional staff	2,503
Supplies and replacements	4,000
Total	Mex. $17,978

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YALE UNIVERSITY SCHOOL OF MEDICINE
DEPARTMENT OF PHYSIOLOGICAL CHEMISTRY

BY

LAFAYETTE B. MENDEL, PH.D., SC.D.

PROFESSOR OF PHYSIOLOGICAL CHEMISTRY

BUILDING AND EQUIPMENT

The Department of Physiological Chemistry occupies the basement and first floor of the Cedar Street wing of the Sterling Hall of Medicine. In the construction of the building the unit principle has been carried out.

FIRST FLOOR

As one enters the main corridor of the building from Cedar Street, the seminar room (26 ft. by 20 ft.) is the first to the right. It is equipped with blackboard, a large table, and seats for about forty people, and contains the bound and unbound volumes of practically all the collected papers of the Department and the dissertations and essays of the students of past years. This room also houses a small part of the departmental library, the remainder being incorporated with the general library on the second floor.

Following the seminar room on the right of the entrance are the secretary's office; Professor Mendel's office of two units (28 ft. by 11 ft.), with private laboratory (Room 126) adjoining; the research laboratory of Professor Smith, also of two units (22 ft. by 16 ft.), with a hood and power centrifuge in addition to the ordinary lab-

FIG. 1.—STERLING HALL OF MEDICINE

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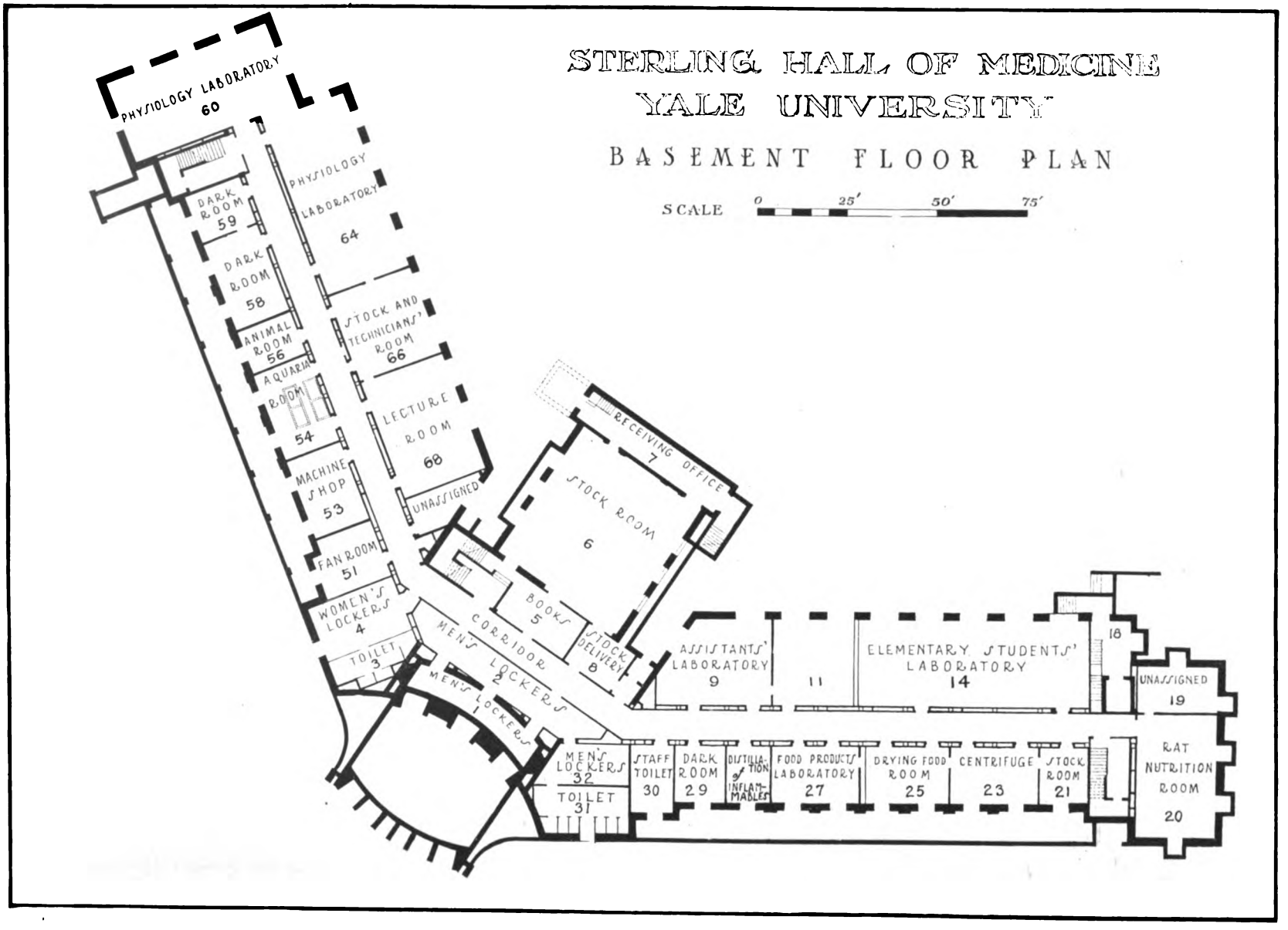

FIG. 2

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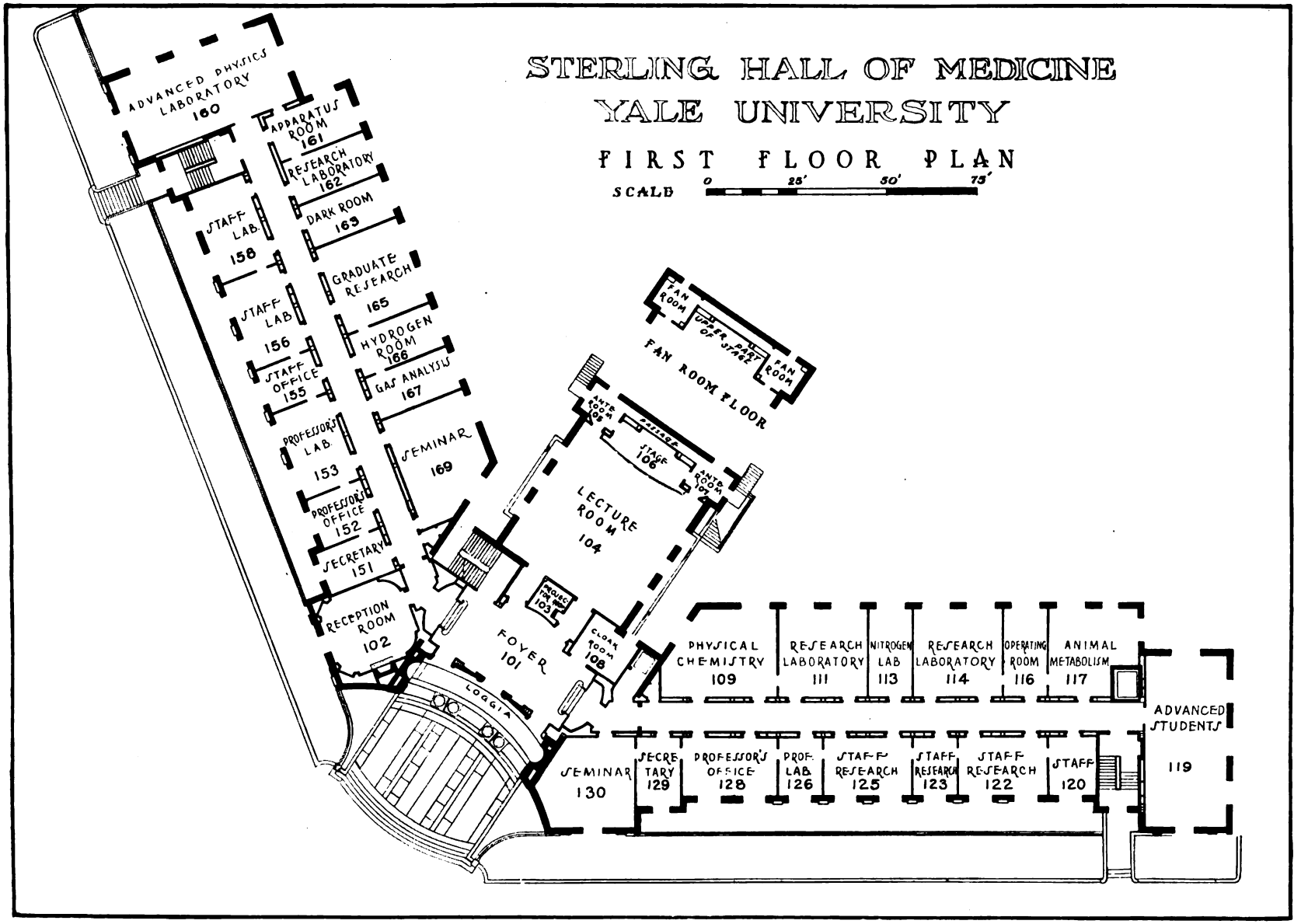

FIG. 3

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FIG. 4.—SEMINAR AND CONFERENCE ROOM

oratory equipment, and private office (13 ft. by 16 ft.). Next follow Dr. Cowgill's office and research laboratory (Room 120) which has the usual chemical equipment, a kymographic apparatus for studying gastric mobility, a chainomatic balance, hood, etc.

At the end of the corridor is the general laboratory (Room 119) for graduate students who have already spent some time in the study of elementary physiological chemistry. During the first semester the students work upon biochemical preparations, and in the second semester they may begin their research here. This room (50 ft. by 25 ft.) will accommodate twenty students. In addition to the usual equipment it contains an alberene hood with twelve steam baths and a small power centrifuge. The animal metabolism room (25 ft. by 25 ft.) contains ten or fifteen dog cages, several rabbit cages, and an alberene sink (2 ft. by 3 ft. by 6 ft.) planned for giving baths to the larger animals. The operating room (13 ft. by 25 ft.) is equipped with an alberene sink, instrument cases, two large mammalian operating tables, and an insufflation apparatus for anesthesia. The operating table is lighted from above by a specially designed cluster of lights.

Room 114 and Room 111 are research laboratories, each accommodating several workers. They are 25 feet by 25 feet, with a desk 10 feet by 4 feet by 5 feet, laboratory tables around the walls, and four alberene sinks with two water faucets, one for use with condensers and one for general use. Room 113 (25 ft. by 10 ft.) is equipped for analytical work, particularly nitrogen estimations. The fumes from the acid digestions are carried away by a hood with forced draft through 6-inch lead pipes to the outside flues. The hood will accommodate twenty-six 700 cc. Kjeldahl flasks at one time, and there are also twenty-six stills, with tubes of block tin for distillations. Titrations are carried out at the end of the room where a large window affords ample light. The "physical chemistry" room (31 ft. by 25 ft.) contains, in addition to the usual equipment, a large refrigerator of four compartments, and a complete hydrogen ion apparatus, consisting of the standard Clark electrode assembly with motor-driven shaker, rheostats, a type K potentiometer, an Epply standard cell, a 2-volt 10-ampere storage cell, an enclosed lamp and scale galvanometer, an extra lamp for galvanometer, and a unit for operating the lamp.

All research and student laboratories in this Department are equipped with the most essential aids, such as hot and cold water, gas, electric cur-

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rent, steam and water baths, centrifuges, air pressure, suction, hoods, electric ovens, and analytical balances.

Basement

All polariscopic and spectroscopic work or other procedures with optical apparatus are carried on in the dark room (16 ft. by 10 ft.), along one side of which is a cabinet containing spectroscopes, polariscopes, colorimeters, nephelometers, refractometers, and their accessories. Room 28 is arranged for the distillation of inflammables and the manipulation of ill-smelling products. It is fitted with a hood with alberene base, reagent shelves, and an alberene table around the three sides of the room. Every precaution is taken here to avert fires. Next to this is a research room (Room 27) which, in addition to the usual equipment, is provided with a chainomatic balance, electric autoclave, and alberene dialyzing sink (2 ft. by 3 ft. by 8 ft.). Mr. W. E. Anderson, Fellow of the Institute of American Meat Packers, is now at work in this room on "The Influence of Diet upon the Quality of Fat produced in the Animal Body." An instructor's research laboratory (Room 25, 18 ft. by 25 ft.), similar to those already described, is followed by the "food preparation" room (Room 23, 18 ft. by 25 ft.) which has a large Grinnell dryer capable of holding twelve trays 2 feet by 2 feet, an extra large power centrifuge, a large meat grinder, a smaller grinder for chemicals and salt mixtures, etc., a Buchner hydraulic press, and large bins for storage.

The main stockroom of the Department is divided into two parts, one (Room 21) for glassware, which is fitted with extra large metal shelves, designed to hold large quantities of chemical glassware, and one for chemicals. The latter is situated just beneath the first floor landing, and is connected with the basement by a stairway. At the end of the basement corridor is the nutrition room (Room 20, 36 ft. by 35 ft.) for small animals, primarily rats and mice. It is provided with seven alberene compartments, each having three shelves capable of holding about sixty small cages; an alberene shelf three feet above the cement floor, which extends around the entire room; and two alberene sinks. Cleanliness, possibility of disinfection, and regulation of the temperature, which throughout the fall, winter, and spring months runs between 76 and 80 degrees Centigrade, are the chief requirements of the rat room. Every effort is made to kill flies, insects, etc., that might find their way in. Adjoining is a smaller room (Room 19, 12 ft.

Fig. 5.—Professor's Office

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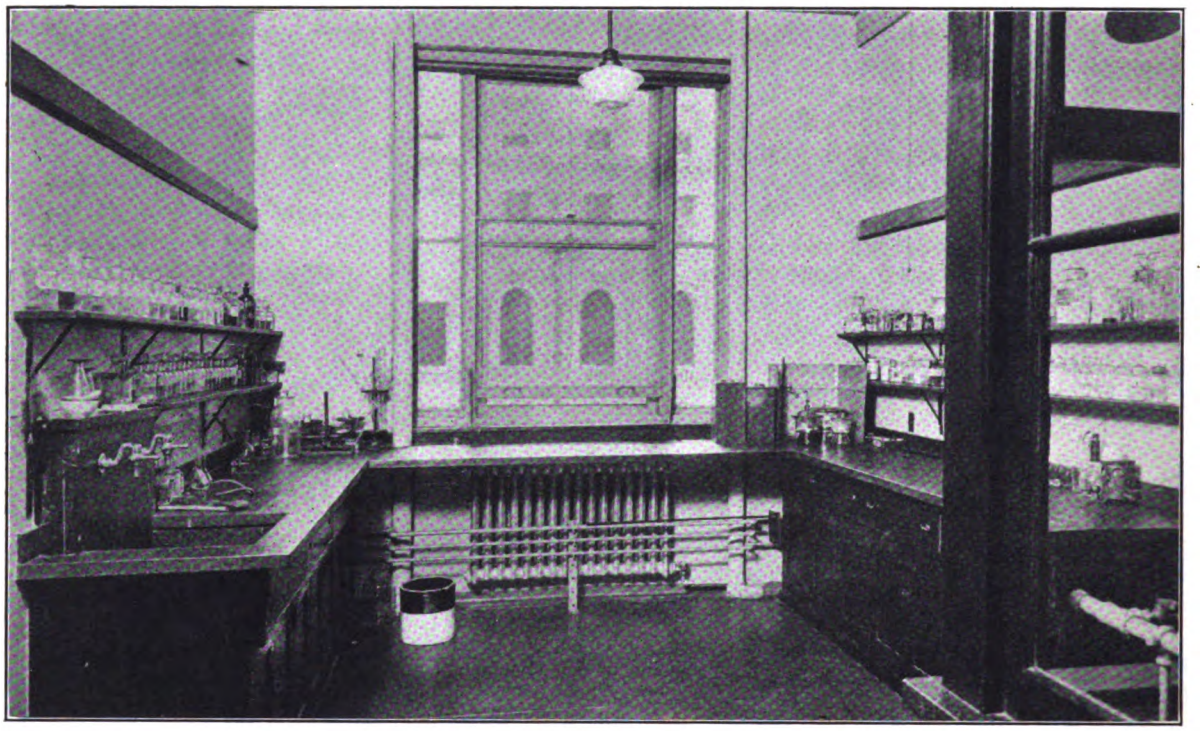

FIG. 6.—ONE-UNIT LABORATORY FOR MEMBERS OF THE STAFF

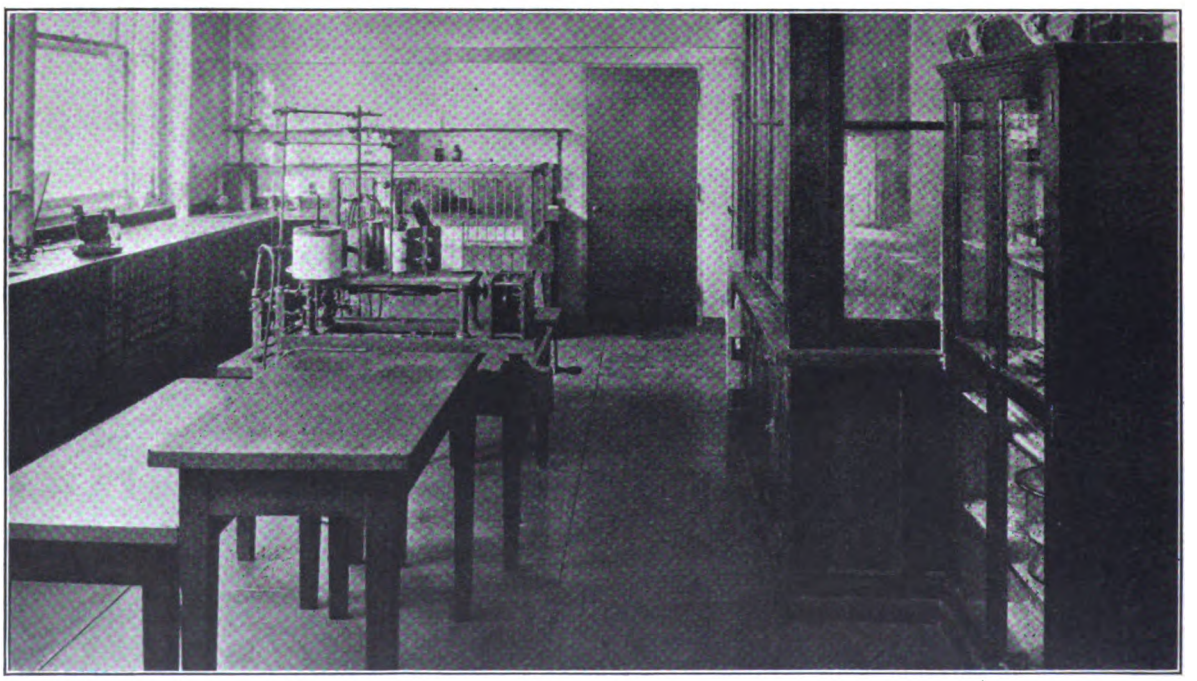

FIG. 7.—TWO-UNIT LABORATORY FOR MEMBERS OF THE STAFF. TYPE OF ROOM IN WHICH CHEMICAL DESKS HAVE NOT BEEN PLACED IN THE CENTER OF THE FLOOR, THEREBY PERMITTING, FOR THE MANY KINDS OF OPERATIONS, DIFFERENT ADJUSTMENTS THAT FIXED DESKS MIGHT NOT ALLOW

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by 25 ft.) devoted to food preparation, cleaning, and sterilizing. It contains about 250 to 300 cylindrical metal rat cages, about forty guinea-pig cages, and cages for pigeons. There is a long table (3 ft. by 12 ft.) in the center of the room, a sink, a steam sterilizer (2 ft. by 3 ft. by 8 ft.), and a large metal cabinet for the storage of food and water cups, trays, etc. As a rule all rat and mouse cages are cleaned twice a week and sterilized with live steam in a steam box for thirty minutes once a week.

The large laboratory for elementary physiological chemistry (Room 14) measures 90 feet by 22 feet, and will accommodate about 100 students. There are nine central laboratory tables, each containing an alberene sink (2 ft. by ½ ft. by 6 ft.) in the center, designed to accommodate eight students. A laboratory table running around the wall of the entire room—with the exception of the hood space—has desks and space for about thirty students. All students' desks are furnished with new equipment. There are besides numerous small wall shelves for the side shelf reagents, a faucet in the center of the room for distilled water, and a four-section hood, each section having six water baths. Abundant light is furnished by seven large windows, and for dark days there are fourteen large electric lights suspended from the top of the room, thus affording sufficient light regardless of the weather. In one end of the laboratory there are two large shelves where the qualitative stock solutions for use of the class are kept. To the left of these is a small centrifuge and shelves for solid chemicals.

Adjoining the large laboratory is the room (Room 9, 20 ft. by 25 ft.) used by the laboratory assistant for the preparation of solutions and materials, etc., for the class, and for his own investigations. In case of necessity it could accommodate ten or twelve more students as it contains one large laboratory table similar to those in Room 14, and shelves along the wall where the solutions are kept. There is also desk space along the outer wall for five or six students. It is the intention of the Department, however, to use this room exclusively as a preparation and research room for the laboratory assistants. It has a large four-compartment refrigerator directly under the one in Room 109, a filter press, and small centrifuge. As the large majority of students taking the elementary course are medical students, and as their time is very limited, effort has been made

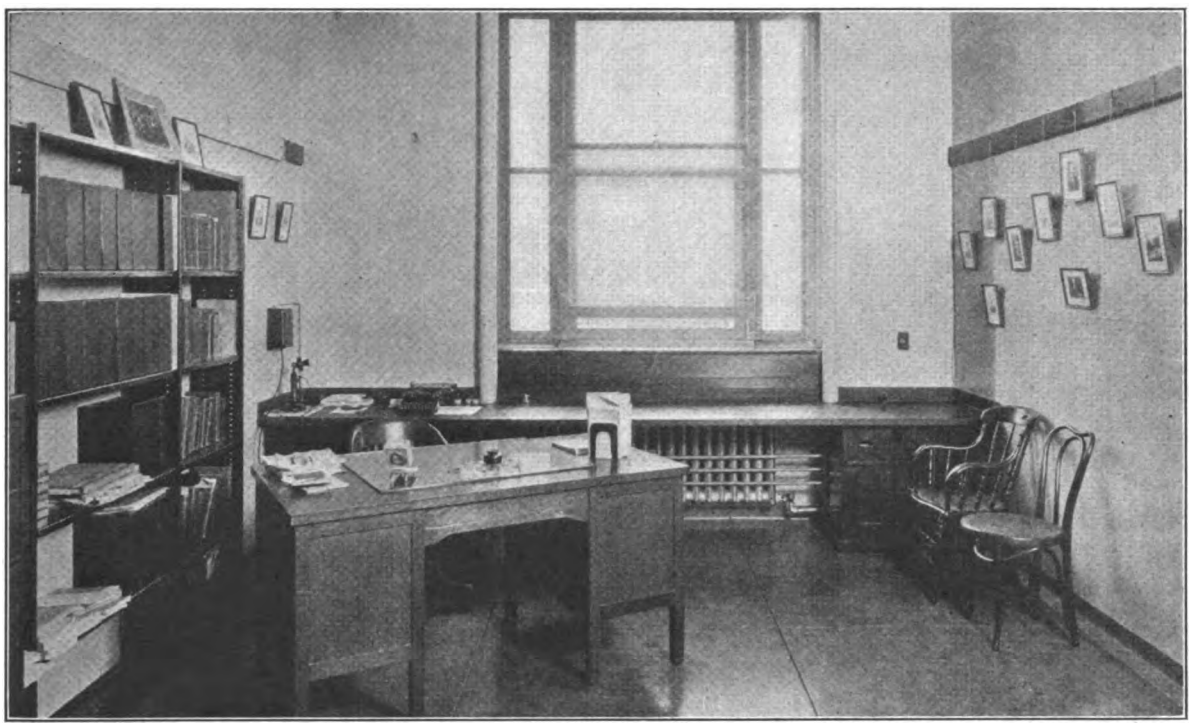

FIG. 8.—ONE-UNIT OFFICE FOR A MEMBER OF THE STAFF, COMMUNICATING DIRECTLY WITH HIS TWO-UNIT LABORATORY

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to unite the large laboratory at one end with the supply room, and at the other with the chemical and glassware stockrooms.

The main stockroom of the building consists of four different rooms, two of which are small and open into the corridor, one being used for the stock delivery and the other for books. The stockroom proper is a large room, 45 feet by 45 feet, in the center of which there are five metal compartments, each containing ninety shelves (3 ft. by 2 ft.). There are also similar compartments around the walls. In the rear, there is a room 45 feet by 8 feet which is used as a receiving room, where all goods for the building are received, and checked by the stockman.

The main animal house for use of all departments is a large room, 60 feet by 45 feet, divided into eleven compartments each consisting of twelve animal cages, 4 feet by 5 feet by 8 feet. Thirty of these cages, or two and one half compartments, are assigned to the Department of Physiological Chemistry. These cages serve both for research and detention purposes for the animals of the different departments, and are intended primarily for dogs. In addition there are two compartments for rabbits and guinea-pigs and the Department of Medicine has twenty cages, 4 feet by 3 feet by 4 feet, for monkeys. The sides and rear of each compartment are of cement, with attachments for cold water and live steam, and the fronts of galvanized iron. The room is situated just behind the main stockroom and entrance to it is by means of a tunnel under this stockroom leading from the sub-basement to the power house in the rear. The animal house has steam heat, electricity, and numerous windows on each side and skylights above which afford ample light and ventilation. The location of the animal house is designed to prevent the noises therefrom from reaching the lecture halls, libraries, etc.

INSTRUCTION AND RESEARCH

The instruction in physiological chemistry is independent of the other departments. All students who enter any of the courses here are expected to have had a preliminary training in analytical and organic chemistry and elementary biology or general physiology. It should be noted that physiology in its broadest aspects is divided at Yale into two categories: physical physiology, taught in the laboratory of physical physiology, and chemical physiology, which is identified essentially with physiological chemis-

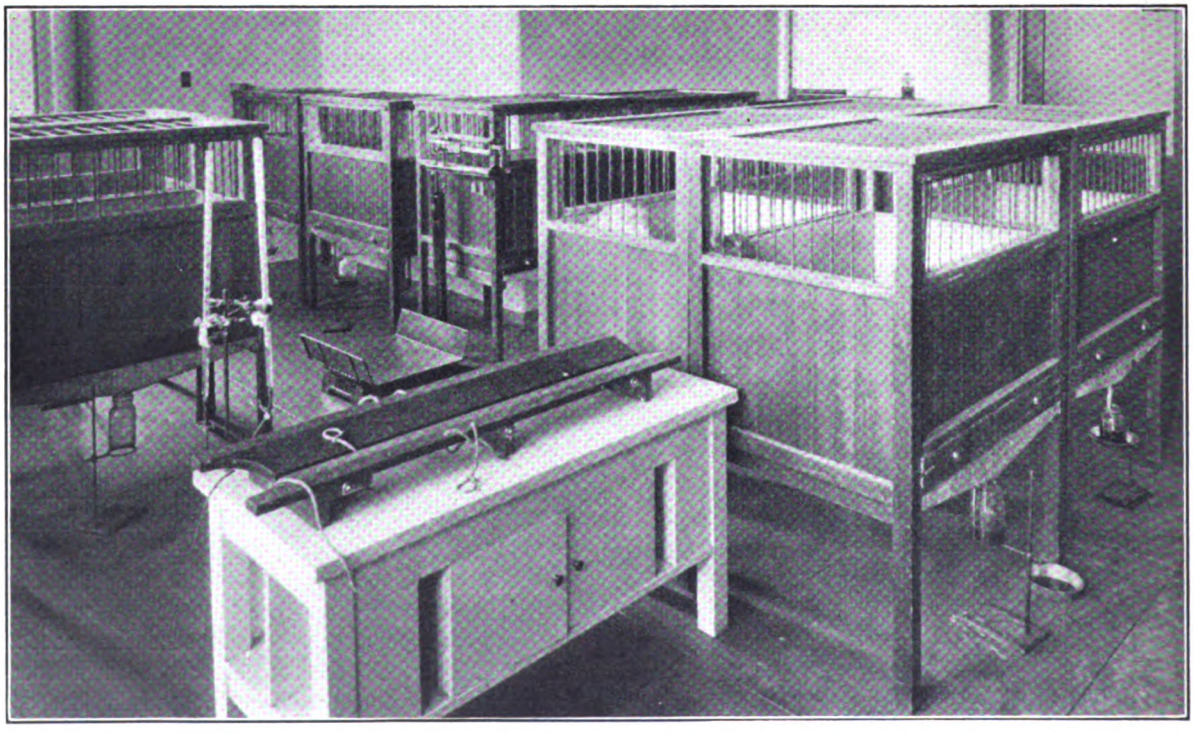

FIG. 9.—METABOLISM LABORATORY FOR LARGER LABORATORY ANIMALS. IN THE FOREGROUND A SPECIAL TABLE FOR CATHETERIZING DOGS. THE ROOM CONTAINS A BATHTUB FOR ANIMALS AND HAS SPECIAL VENTILATING DEVICES

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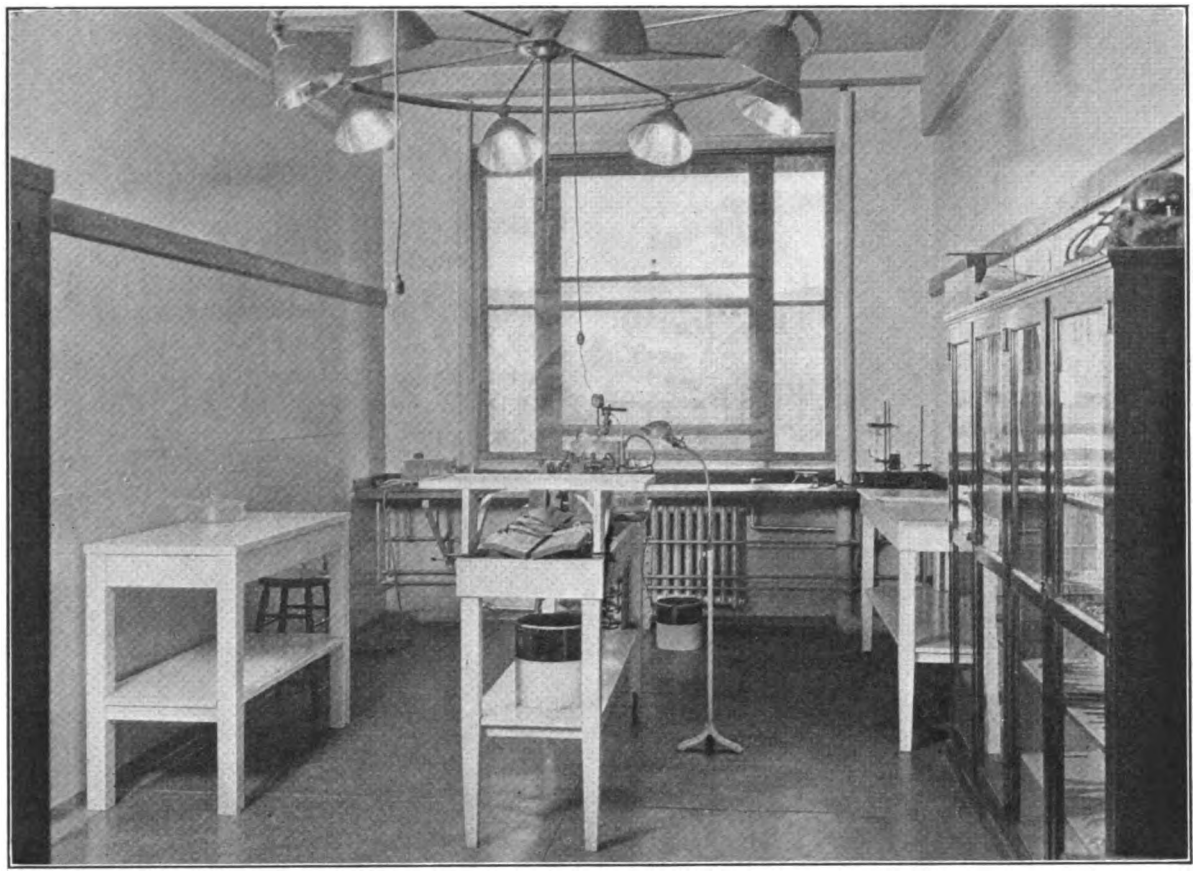

FIG. 10.—OPERATING ROOM

try. The subject thus has a somewhat broader content at Yale than the so-called biochemistry that is taught elsewhere as an adjunct to the Department of Chemistry.

For lectures given by the staff, the conveniently located main auditorium of the building, which will seat over 200 people, is available. Occasionally the seminar room is used for conferences of smaller groups of students. For example, Professor Mendel in this room holds the weekly physiological seminar throughout the year. The participants are required to prepare reports on papers appearing in English, German, and French physiological literature, and these are discussed in connection with the recent advances in physiology and physiological chemistry.

Descriptions of the courses offered in this Department follow:

Physiology 100a. Physiological chemistry

A laboratory course and lectures dealing with the more important constituents of animals and plants; chemistry of the epithelial, connective, contractile, and nervous tissues; chemical processes of salivary, gastric, pancreatic, and intestinal digestion and other chemical aspects of secretion, excretion, and metabolism. Knowledge of inorganic and organic chemistry, and of elementary biology or physiology is essential. This course is required of all students in the School of Medicine and the combined medical courses in the undergraduate schools. Twelve hours, first term.

Physiology 105. Advanced physiological chemistry

Students who have sufficient knowledge of analytical and organic chemistry and elementary physiology and general biology may pursue the study of physiological chemistry throughout the entire year. Those who have only a limited time and desire to study special topics are received, provided they are qualified by previous work to study advantageously. The advanced course covers in a more comprehensive manner the general plan outlined in Physiology 100a. Twelve hours throughout the year.

Physiology 106. Special methods of investigation in physiological chemistry

Individual and group instruction for those who have had preliminary training in the field of physiological chemistry and intend to prepare for a career in research. It includes a laboratory study of selected topics. Separation, purification, and identification of various products of biochemical interest are attempted. The course counts for five hours.

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Physiology 107b. Quantitative methods in physiological chemistry

Systematic instruction for those who have had preliminary training in physiological chemistry and physiology. Designed to familiarize the student with the special chemical methods employed in the analysis of blood and urine. Twelve hours, first half of second term.

Physiology 110b. Physiology of nutrition

Lectures, demonstrations, and quizzes, on the physiology of the vegetative functions. The subject of nutrition in its broadest aspects, including the mechanisms of alimentation, metabolism, respiration, etc., is reviewed comprehensively. Knowledge of inorganic and organic chemistry and of elementary physiology or general biology is essential. Intended to follow a laboratory course in physiological chemistry, such as physiology 100a. Two hours, second term.

Physiology 115. Physiological seminary

Participants are required to prepare reports of papers appearing in the English, German, and French physiological literature; and these are discussed in connection with the recent advances in physiology and physiological chemistry. Two hours.

Chemistry 176. Biochemistry seminary

Designed for students specializing in organic and physiological chemistry. Classical biochemical researches of mutual interest to chemist and physiologist are discussed, and the students are required to report upon assigned topics dealing with recent advances in biochemistry. Seven seminaries during the year.

In addition to the above courses persons who have the requisite training are received into the laboratory to conduct investigations under guidance. This applies particularly to candidates for the higher degrees and to independent workers such as visiting scientists or holders of traveling fellowships. The subjects of research deal with the field of nutrition in its broadest aspects and are best exemplified by the publications of the members of the staff, a bibliography of which appears in the annual reports of the President of the University. The following is a list of papers published recently, together with the subjects at present under investigation:

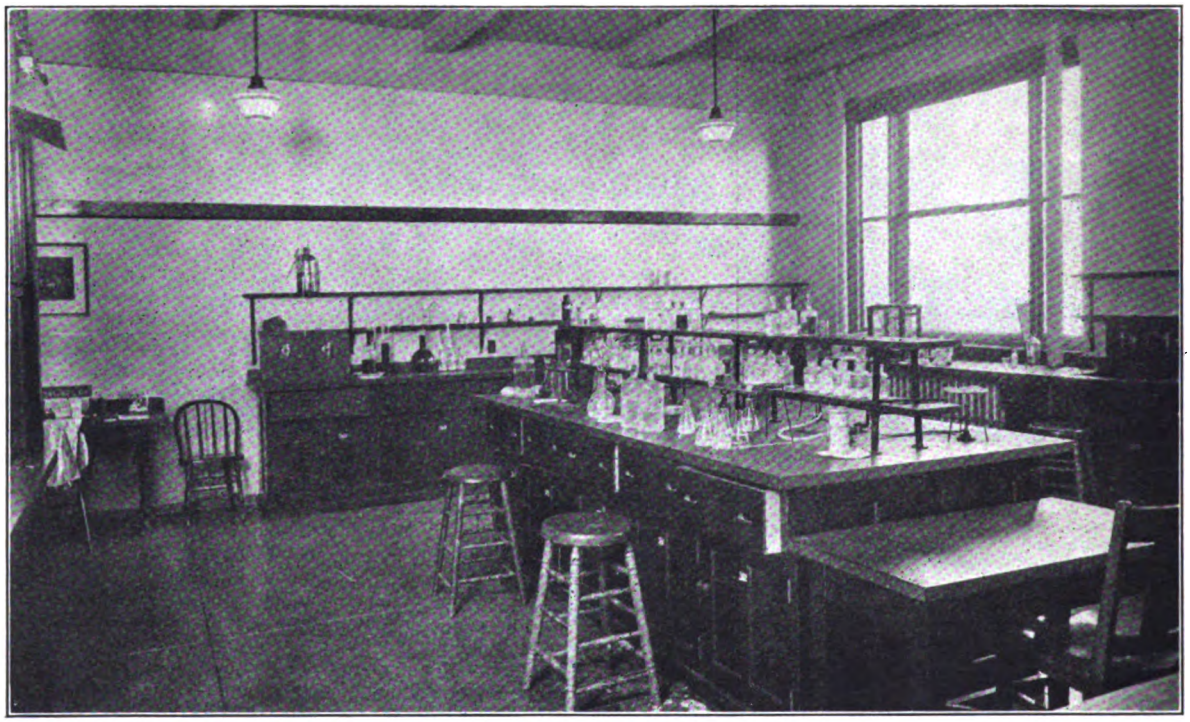

FIG. 11.—TYPICAL RESEARCH LABORATORY FOR GRADUATE STUDENTS

LAFAYETTE B. MENDEL

Nutrition; The chemistry of life (*Yale Univ. Press*, 1923); Evidence expérimentale du manque de vitamine dans l'Alimentation (*Bull. Soc. sc. d'hyg. aliment.*, Paris, 1924, v. 12, p. 29-37). With THOMAS B. OSBORNE: Milk as a source of water-soluble vitamin (*Biochem. J.* Cambridge, 1922, v. 16, p. 363-367); Quantitative aspects of the rôle of vitamin B in nutrition (*J. Biol. Chem.*, 1922, v. 54, p. 739-752); Eggs as a source of vitamin B (*J. A. M. A.*, 1923, v. 80, p. 302-303); The nutritive value of lactalbumin (*J. Biol. Chem.*, 1924, v. 59, p. 339-345); Nutrition and growth on diets highly deficient or entirely lacking in preformed carbohydrates (*J. Biol. Chem.*, 1924, v. 59, p. 13-32); Nutrition and growth on diets highly deficient or entirely lacking in preformed carbohydrates (*Am. J. Physiol.*, 1924, v. 68, p. 143); Nutrition and growth on diets highly deficient or entirely lacking in preformed carbohydrates (*J. Biol.*

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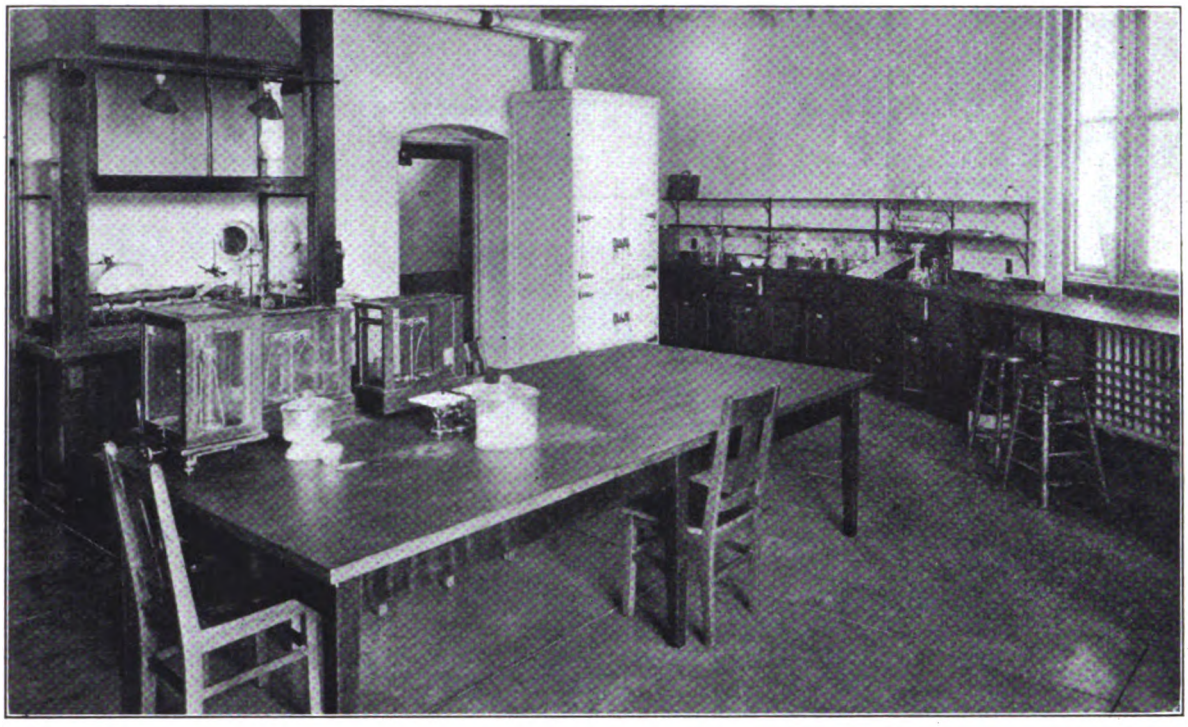

FIG. 12.—RESEARCH LABORATORY PARTICULARLY DESIGNED FOR PHYSICAL CHEMISTRY WORK. REFRIGERATION SYSTEM AND DIALYSIS DESK TANKS SHOWN

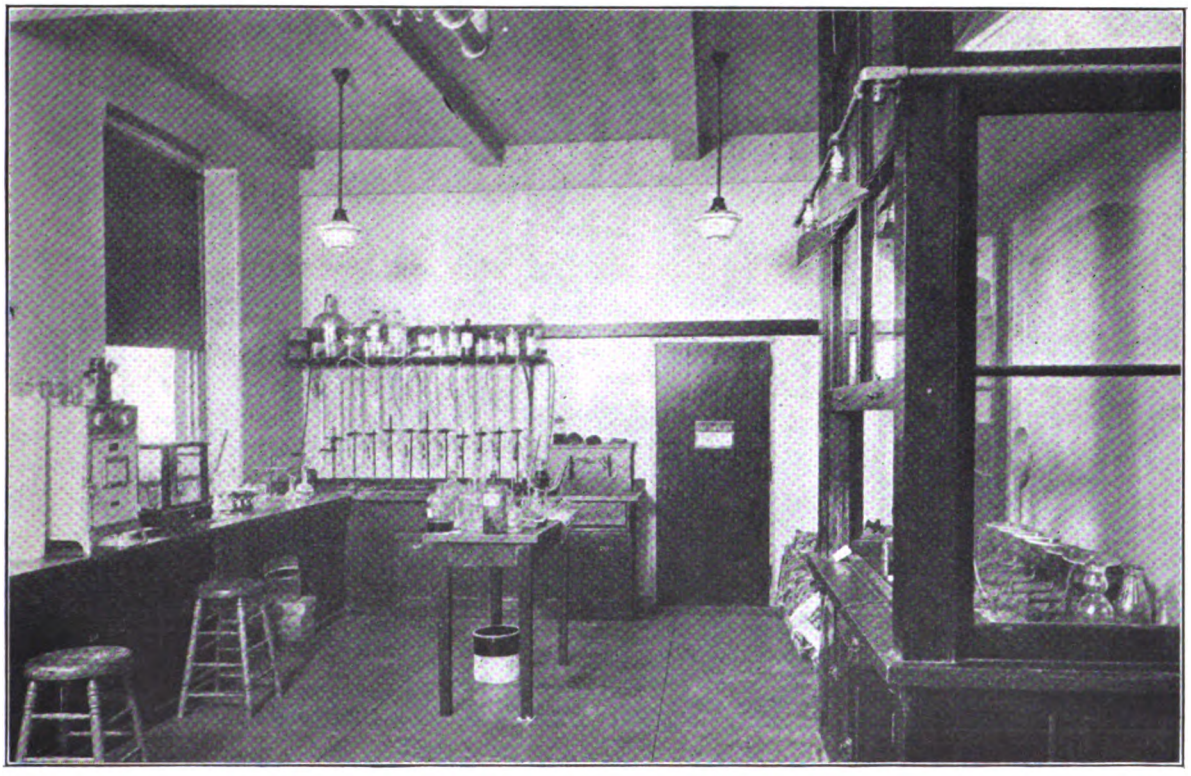

FIG. 13.—TWO-UNIT RESEARCH LABORATORY SHOWING TYPES OF HOODS AND CUPBOARDS IN USE

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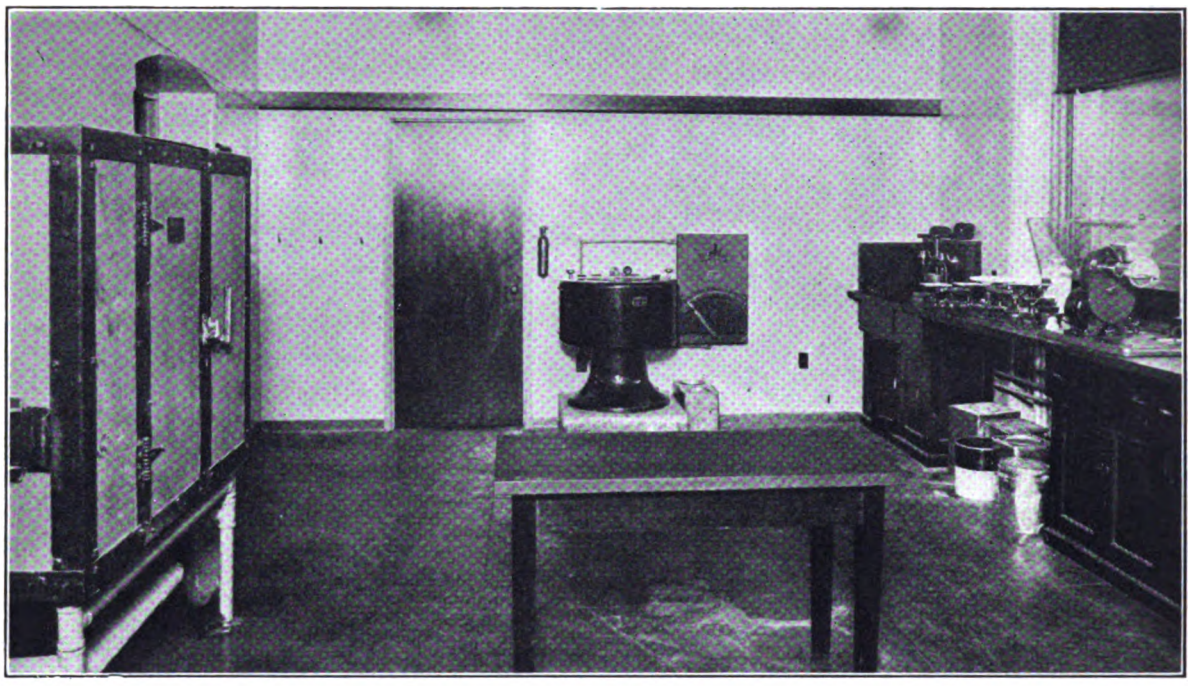

FIG. 14.—FOOD PREPARATION ROOM, EQUIPPED WITH SUPER-CENTRIFUGE AND GRINDING APPARATUS

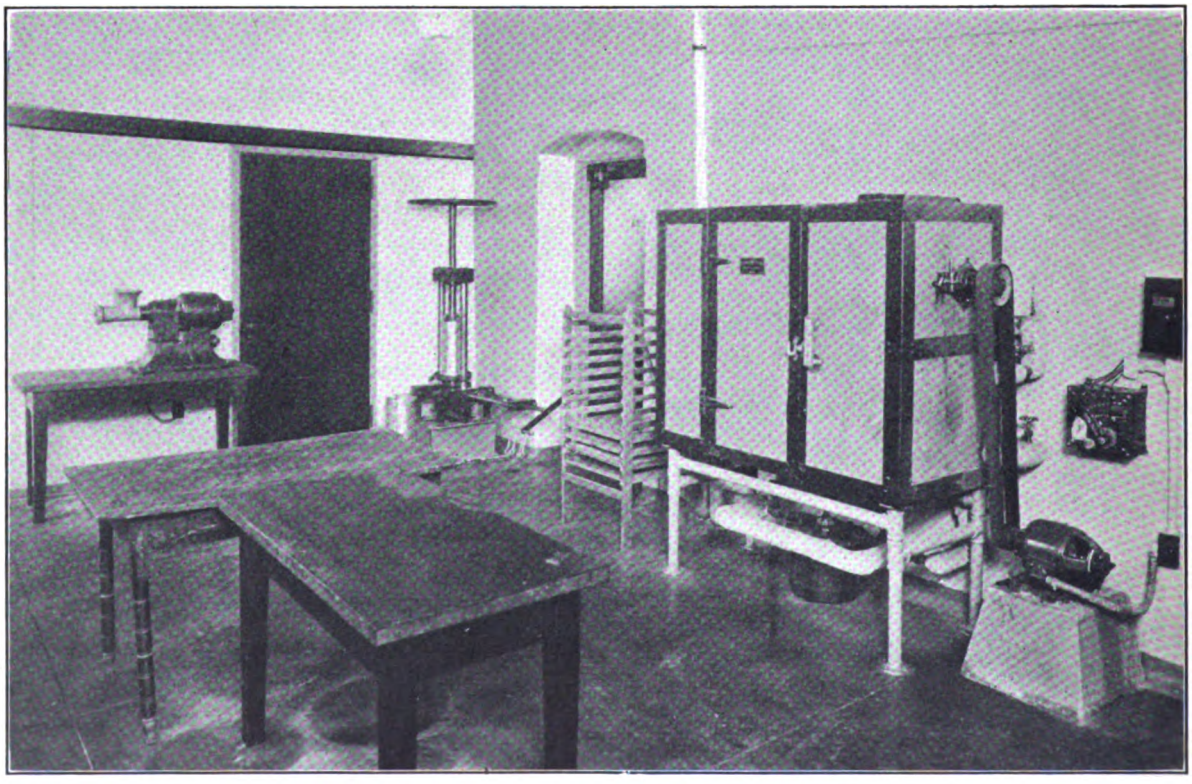

FIG. 15.—PART OF FOOD PREPARATION ROOM, SHOWING GRINNELL DRIER, BUCHNER PRESS, AND HOBART MILL

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Chem., 1924, v. 59, p. 13-32; Proc. Soc. Biol. Chem., p. xliv); The effect of diet on the content of vitamin B in the liver (*J. Biol. Chem.*, 1923, v. 58, p. 363-367); Continuation and extension of work on vegetable proteins (*Carnegie Institution Year Book for 1923*, 1924, v. 22, p. 340-346). With THOMAS B. OSBORNE and EDWARDS A. PARK: Experimental production of rickets with diets of purified food substances (*Proc. Soc. Exper. Biol. & Med.*, 1923, v. 21, p. 87-90). With FLORENCE B. SIEBERT: Temperature variations in rabbits (*Am. J. Physiol.*, 1923, v. 67, p. 83-89); Protein fevers with special reference to casein (*Am. J. Physiol.*, 1923, v. 67, p. 105-123). With WILLIAM E. ANDERSON: A technique for the study of fat production in animals (*Proc. Soc. Exper. Biol. & Med.* In press). With DAVID N. SHULMAN: The blood platelets in rats on adequate and inadequate diets (*Proc. Soc. Exper. Biol. & Med.* In press). With ALFRED CHANUTIN and ARTHUR H. SMITH: Factors concerned in blood volume regulation (*Am. J. Physiol.*, 1924, v. 68, p. 444-460).

Studies now in progress: With MARION FAY: Interrelations of nitrogen and sulphur metabolism. With HILDA CROLL: Vitamin B in corn. With MINETTE NEWMAN: Vegetable proteolytic enzymes. With VERA GODDARD: Vegetable hemagglutinins. With ROSSLEENE ARNOLD: The chemical relation of blood and lymph. With GEORGE A. WILLIAMS: The chemical aspects of catharsis with bran. With HOWARD H. BEARD: Experimental study of the deficiency diseases in white mice.

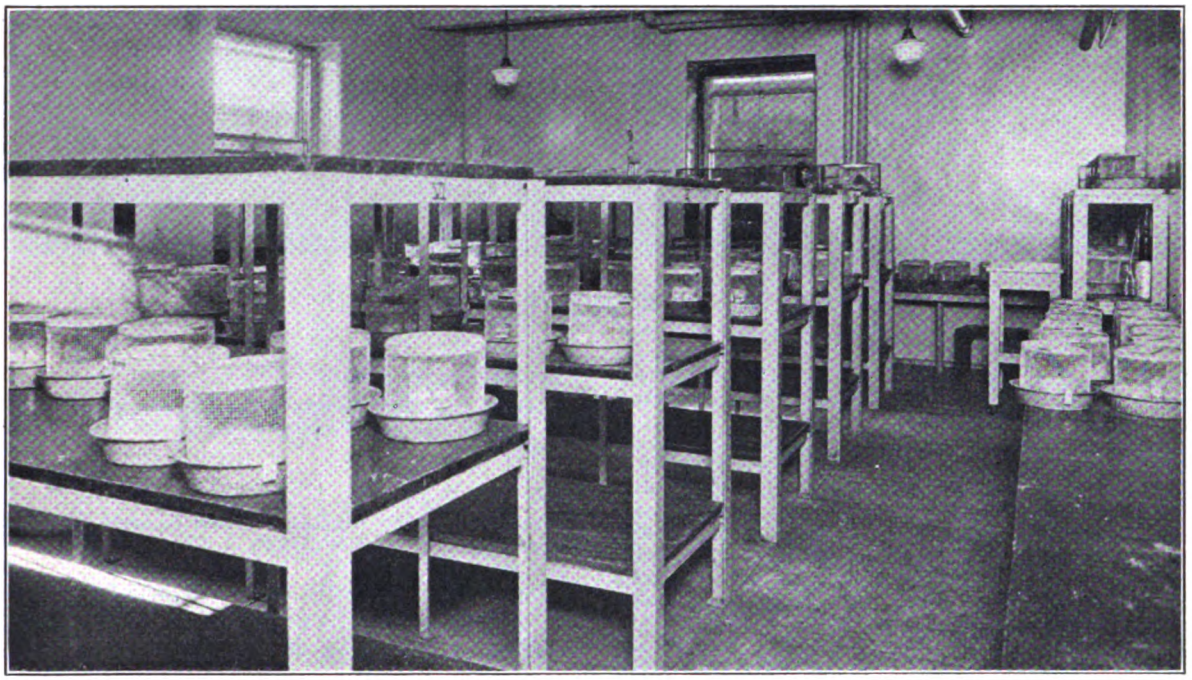

FIG. 16.—VIEW OF NUTRITION LABORATORY FOR EXPERIMENTS WITH SMALLER ANIMALS SUCH AS RATS AND MICE. THE SHELVES AND DESKS ARE MADE OF IRON AND ALBERENE. A PREPARATION ROOM WITH STERILIZERS, ETC., IS CONNECTED WITH IT

ARTHUR H. SMITH

Vitamins in ice cream (*J. A. M. A.*, 1922, v. 79, p. 2221-2222). With WALTER L. KULP: The effect of change in type of intestinal bacteria on urinary indican and phenols (*Proc. Soc. Exper. Biol. & Med.*, 1922, v. 20, p. 44). With WILLIAM E. ANDERSON: Postscorbutic nutrition in the guinea-pig (*J. Biol. Chem., Proc. Soc. Biol. Chem.*, 1924, v. 59, p. viii-ix). With T. S. MOISE: Diet and tissue growth. I. The regeneration of liver tissue on various adequate diets (*J. Exper. M.*, 1924, v. 40, p. 13-23); Diet and tissue growth. II. The regeneration of liver tissue during nutrition on inadequate diets and fasting (*J. Exper. M.*, 1924, v. 40, p. 209-218). With ELIZABETH CAREY: Growth on diets high in carbohydrate and high in fat (*J. Biol. Chem.*, 1923, v. 58, p. 425-433). With GEORGE R. COWGILL and H. J. DEUEL, JR.: Quantitative aspects of the relation between vitamin B and appetite (*J. Biol. Chem., Proc. Soc. Biol. Chem.*, 1924, v. 59, p. xi-xii). With LAFAYETTE B. MENDEL and ALFRED CHANUTIN: Factors concerned in blood volume regulation (*Am. J. Physiol.*, 1924, v. 68, p. 440-460). With MATHILDE L. KOCH: The variation of complement of guinea-pigs during scurvy (*Proc. Soc. Exper. Biol. & Med.*, 1924, v. 21, p. 366-368). With T. S. MOISE: Diet and tissue regeneration (*Proc. Soc. Exper. Biol. & Med.*, 1923, v. 20, p. 440); The nature of some deficiency diseases (*Annals of Otology, Rhinology and Laryngology.* In press); The centenary of a unique discovery (*Scient. Month.*, 1923, v. 17, p. 238-244). With JOHN E. ANDERSON: The relation of diet to the learning process (In press). With HAROLD LEVINE: Diet and ketosis; The proteins of orange juice.

GEORGE R. COWGILL

Vitamin B as a factor in nutrition (*The Nation's Health*, 1923, p. 509-510, 561); An improved procedure for metabolism experiments (*J. Biol. Chem.*,

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FIG. 17.—LARGE STUDENT LABORATORY

1923, v. 56, p. lvi., 725-737); Studies in the physiology of the vitamins. II. Parental administration of vitamin B—Mammalian experiments (*Am. J. Physiol.*, 1923, v. 66, p. 164-175); Some historical aspects of experimental physiology (*Scient. Month.*, 1924, v. 18, p. 401-407). With H. J. DEUEL, JR.: Vitamin B and the appetite of the dog; Quantitative aspects (*Proc. 11th Internat. Physiol. Cong.*, Edinburgh, Scotland, 1923); A comparison of the paths of absorption with respect to the action of secretin upon the pancreas (*Proc. 11th Internat. Physiol. Cong.*, Edinburgh, Scotland, 1923). With N. H. PLUMMER and H. J. DEUEL, JR.: The rôle of the liver in pancreatic secretion (*Proc. Soc. Exper. Biol. & Med.*, 1924, v. 21, p. 380-381); The relation of avitaminosis and gastric motility (In press); The energy requirement on various diets (In press).

TAKEO INOUYE, National Research Council Fellow

The question of fat absorption from the mammalian stomach (*Am. J. Physiol.*, 1924, v. 69, p. 116-124); Diet and parathyroid tetany (In press).

WILLIAM E. ANDERSON, Fellow of the Institute of American Meat Packers' Assn.

The relation of diet to the chemical constants of body fat (In press).

HARRY J. DEUEL, JR.

The metabolism of some pyrimidines (*J. Biol. Chem.* In press).

ARTHUR M. YUDKIN

With ROBERT A. LAMBERT: Changes in the paraocular glands accompanying the ocular lesions which result from a deficiency of vitamin A (*J. Exper. M.*, 1923, v. 38, p. 25-32); Pathogenesis of ocular lesions produced by a deficiency of vitamin A (*J. Exper. M.*, 1923, v. 38, p. 17-24).

FRANCISCO O. SANTOS

Metabolism experiments with Filipino students in the United States (*Philippine J. S.*, 1923, v. 23, p. 51-66).

FLORENCE B. SIEBERT

Fever-producing substance found in some distilled waters (*Am. J. Physiol.*, 1923, v. 67, p. 90-104).

The correlations with other subjects vary with the nature of the investigation in progress. Hitherto co-operative studies have been prosecuted for many years with the departments of organic chemistry, bacteriology, pathology, and pediatrics, as well as with the Connecticut Agricultural Experiment Station. Professor Mendel has continued his investigations in nutrition as research associate of the Carnegie Institution of Washington, in co-operation with Dr. Thomas B. Osborne of the Connecticut Agricultural Experiment Station. He is also collaborating with Professor Underhill in investigations of certain dietary deficiencies in dogs. This study has been promoted in part during the present year through collaboration with the United States Public Health Service, which has furnished funds for these experiments. Dr. Smith has given a series of lectures on nutrition at the Allingtown Hospital to the doctors and nurses of the United States Public Health Service on duty with the

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Veterans' Bureau. He has also been collaborating with Dr. T. S. Moise of the Department of Surgery in extensive studies on diet and tissue regeneration, and with Dr. John E. Anderson of the Department of Psychology in a study of the effect of diet on memory factors in rats.

STAFF

All members of the staff are on a full-time basis. The professional staff consists at the present time of a professor, an assistant professor, two instructors, three assistants, and two laboratory assistants. In addition to this two janitors serve the laboratory. The personnel of the staff is as follows:

Lafayette B. Mendel, Ph.D., Sc.D., chairman, professor of physiological chemistry.

Arthur H. Smith, Ph.D., assistant professor of physiological chemistry.

George R. Cowgill, Ph.D., instructor in physiological chemistry.

Hilda Croll, B.A., M.A., instructor in physiological chemistry in the Yale School of Nursing.

Marion Fay, B.A., M.A., assistant in physiological chemistry.

Harold Levine, B.S., assistant in physiological chemistry.

Rossleene Arnold, A.B., M.A., assistant in physiological chemistry.

Howard H. Beard, B.S., M.A., laboratory assistant in physiological chemistry.

George A. Williams, A.B., M.S., laboratory assistant in physiological chemistry.

SPECIAL RESEARCH FELLOWS

William E. Anderson, M.A., fellow of the Institute of American Meat Packers.

Takeo Inouye, M.D., Rockefeller Foundation fellow.

David Drabkin, M.D., medical fellow of the National Research Council.

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PEKING UNION MEDICAL COLLEGE DEPARTMENT OF SURGERY

BY

ADRIAN S. TAYLOR, M.D.

PROFESSOR OF SURGERY

PHYSICAL EQUIPMENT

The work of the Department of Surgery is largely carried on in "J" Building which provides accommodations for the operating theaters, the surgical laboratories, and the surgical Out-Patient Department. The surgical wards immediately adjoin this building and are connected with its several floors by short, covered corridors.

"J" Building is a large four-story building with the north side entirely unobstructed. Its top floor overlooks, to the south, the green-tiled roofs of the other buildings of the College, while from its northern windows the whole panorama of Peking with the yellow-roofed Forbidden City in its center stretches out toward the Western Hills.

The fourth floor is given over entirely to the operating theaters, sterilizing and preparation rooms, and the offices for the head nurse and chief surgeon of the Hospital. There are five operating rooms for the work in general surgery, gynecology, ophthalmology, otolaryngology, and oral surgery. Two rooms are assigned to general surgery, while the others are used on alternate days by the special surgical departments. Each operating room has convenient access to a small etherizing room, a scrub room, and an instrument sterilizing room. Lighting is provided for by large north windows and skylights and by electric lights hung in a circle above the table and focussed on the operating field by a ring of parabolic reflectors, giving shadowless illumination at all times. The floors and side walls of the theaters are covered with a very hard, dark green tile which eliminates all glare. Electric current is supplied from the 110 volt direct current line, and also in low voltage from storage batteries for the lighting of small diagnostic instruments. Each theater is also connected with the electro-cardiographic laboratory on the second floor, and is piped for compressed air, illuminating gas, nitrous oxide and oxygen, and for suction. Nitrous oxide, manufactured on the premises, is either piped to the operating rooms under low pressure or is compressed into small steel tanks for use with the gas machines.

The size of the theaters, 23 feet by 14½ feet, is proving too small even for the very limited numbers in the surgical sections. In the original plans no provision was intended to be made for amphitheater teaching during operations. The operating suite was therefore planned to accommodate small groups in each room. At the present time, investigations are being undertaken looking toward the building of balconies to be entered from the unoccupied loft above. Architectural and structural considerations have made it impossible to alter the size of these theaters, but experience has shown that at least two feet more, that is 16½ feet, should be allowed for the dimension of the room parallel to the long axis of the operating table.

The surgical laboratories are on the third floor immediately beneath the operating suite. They provide private laboratories for bacteriological, pathological, and operative work, and are equipped with incubators, centrifuges, chemical hoods, dressing and instrument sterilizers, animal operating rooms, storage space for small animals, and the apparatus necessary for certain bacteriological and chemical research. Laboratory courses illustrating fundamental surgical principles as well as surgical technique are given here for graduate and undergraduate students.

The surgical Out-Patient Department is on the first floor. Examining rooms for men and women, a small operating theater for minor and emergency surgery, and a plaster room for orthopedic work are provided. Facilities for genito-urinary out-patient surgery are provided

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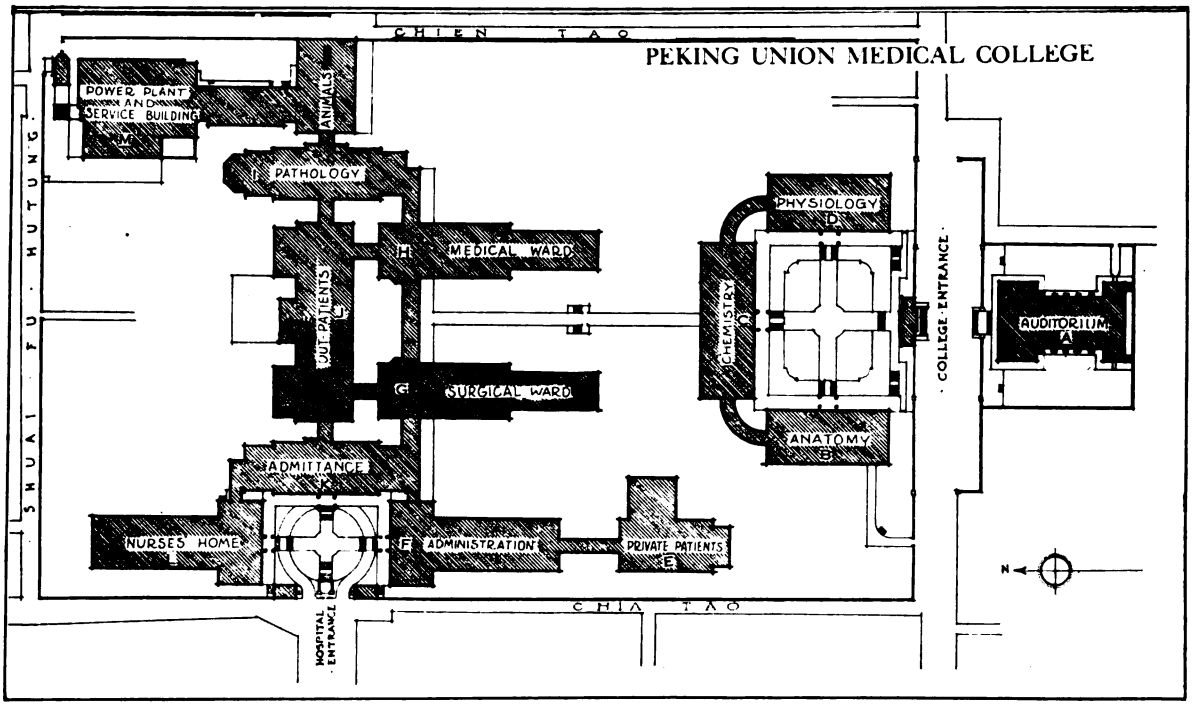

FIG. 1.—GROUND PLAN OF MEDICAL SCHOOL AND HOSPITAL BUILDINGS. CLINICAL LABORATORIES AND OPERATING ROOMS ON UPPER FLOORS OF "J" BUILDING

for in a separate suite across the corridor from the quarters for general surgery. The surgical wards immediately adjoin the out-patient building. Each ward contains sixteen beds in a large well-lighted central room, with a small four-bed glassed-in solarium at the south end, service rooms, private rooms for very ill patients, and a small five-bed ward at the north end. Each ward has its own interne's laboratory and a very useful clinical teaching room where patients may be taken for class demonstration. The principal clinical classroom or amphitheater of the College is easily reached from any of the surgical wards. The surgical unit is three stories high and on each floor there is a complete ward as described. Each floor is connected with the corresponding floor of "J" Building by a level corridor. Large elevators connect the floors.

The private wards in "E" Building provide ample accommodation for first-class surgical patients. Patients referred by physicians at a distance for diagnosis and treatment are increasing in number and form a valuable part of the surgical clinic.

During the year 1922-1923, 35,365 patients were treated in the surgical Out-Patient Department, 880 were admitted to the surgical wards, and 871 operations were done by the surgical service, exclusive of the work in the Out-Patient Department and in oral surgery. During ten months of 1923-1924 there was approximately a 13 per cent increase. This material is ample for the teaching needs of the institution at the present time.

TEACHING METHODS AND FACILITIES

Second-year students begin their surgical work with a course in the Hunterian Laboratory which is intended to illustrate the application of the fundamental preclinical sciences to surgical problems. This course has been given increased emphasis in the proposed new curriculum of the College as one of the best means of correlating preclinical and clinical studies. The course consists of twenty-four exercises of four hours each, and provides for observations upon animals after operation under anesthesia and with sterile technique, for taking material for study from experimentally produced lesions of many kinds, for elementary training in surgical technique, and for full group discussion to which instructors from the departments of anatomy, physiology, bacteriology, and pathology are invited. The greatest effort is made to help the student connect his preclinical studies with the instruc-

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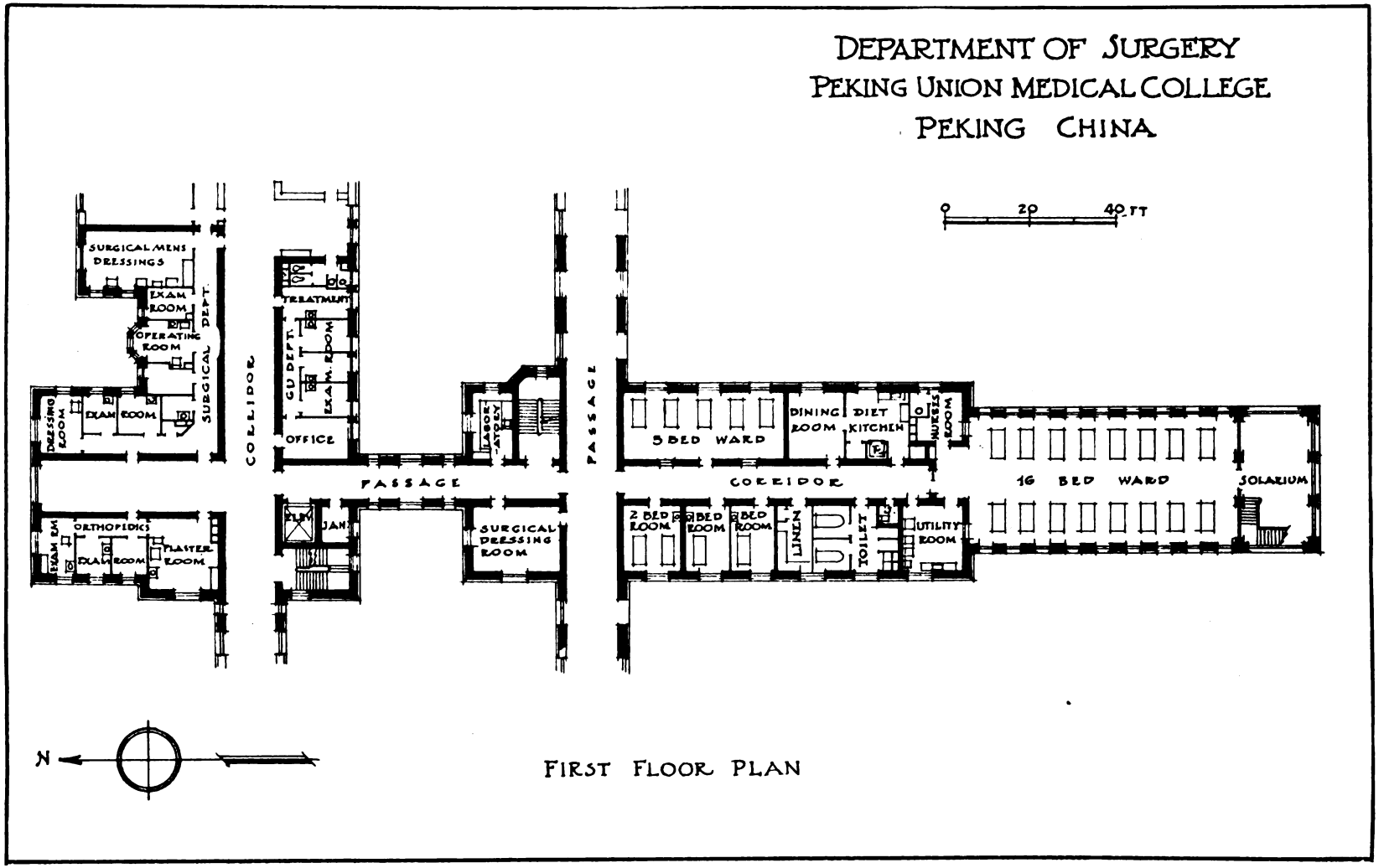

FIG. 2

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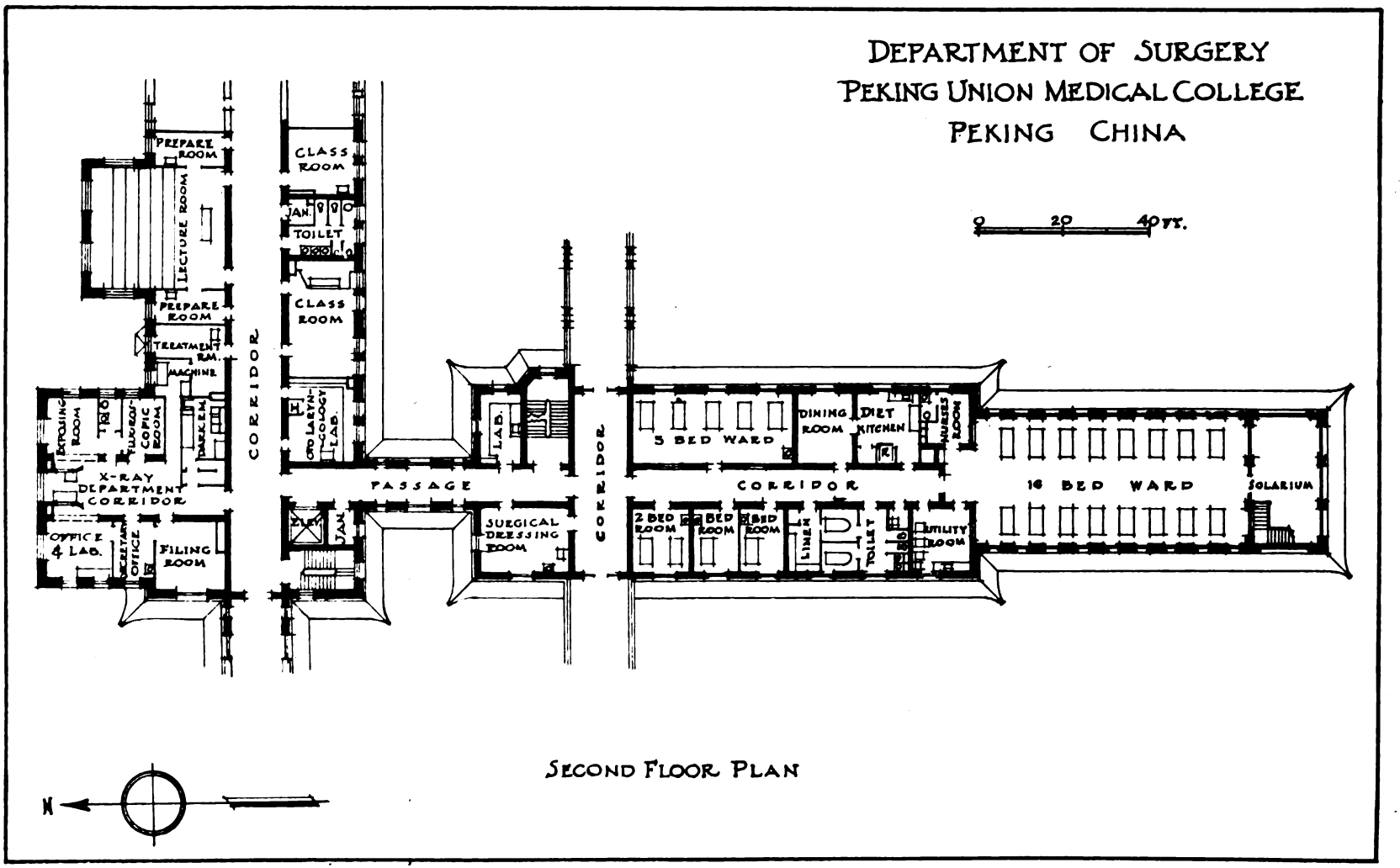

SECOND FLOOR PLAN

FIG. 3

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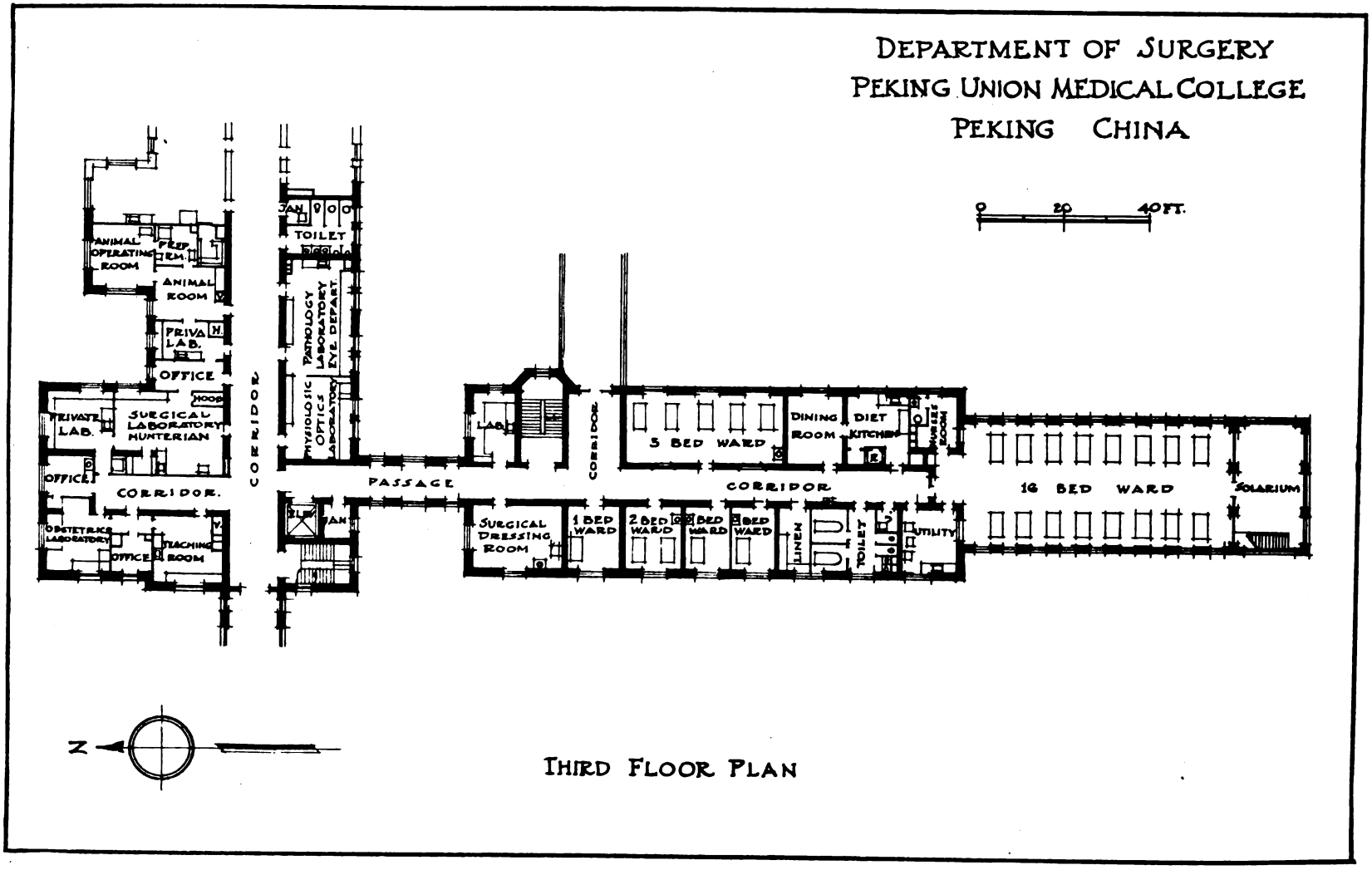

THIRD FLOOR PLAN

FIG. 4

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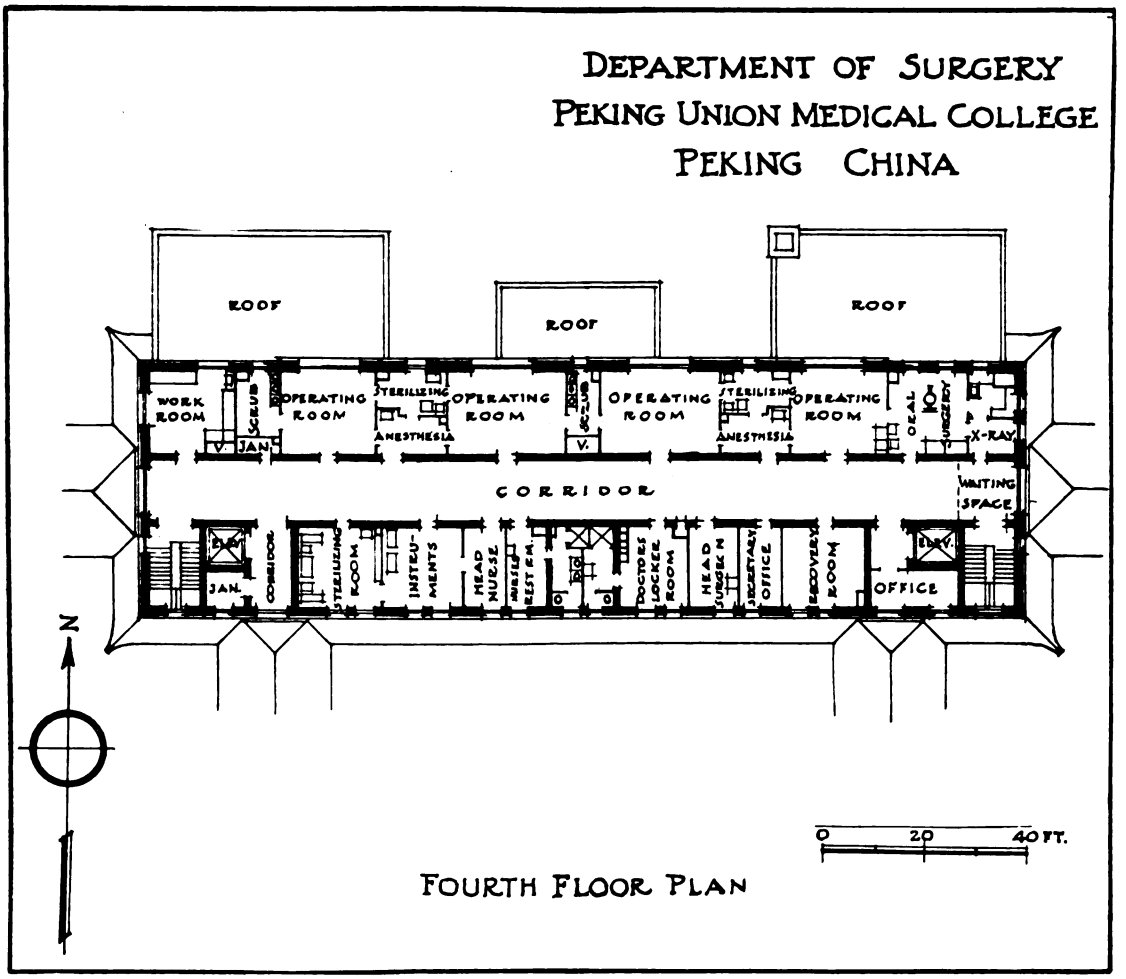

FIG. 5

tion given in surgery, in order to prepare him for applying his recently acquired knowledge of the fundamentals to the solution of the varied problems that will soon confront him in the clinic.

Surgery 2 begins in the first trimester of the third year and continues throughout the year. It consists of 104 hours, and the teaching is largely by the case method, although an effort is made to present the subject of general surgery in a connected and comprehensive way. The growing clinic is already furnishing sufficient material to make this possible.

Surgery 3 is an out-patient course for third-year men, beginning in the first trimester. The student is taught to take histories, examine patients, apply bandages and dressings, and is shown the technique of minor operations. Surgery 4 is a direct continuation of this course and runs throughout the rest of the third year. New patients are assigned to the students individually; they write the histories, make the physical examinations, record their diagnoses, and suggest treatment. The cases are then gone over with the students by the instructor who discusses the diagnoses and the prescribed therapy and directs the student in personally carrying out whatever surgical treatment may be proper at that time, great effort being made to allow the student the maximum responsibility in the treatment.

Surgery 5 is a demonstration clinic held once a week throughout the year for third- and fourth-year men. Important cases are shown, diagnoses discussed, and very often operations are performed before the group.

Surgery 6 is a short course given in the Out-Patient Department during the third year, illus-

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FIG. 6.—CORRIDOR OF THE OUT-PATIENT DEPARTMENT

FIG. 7.—OUT-PATIENT DEPARTMENT

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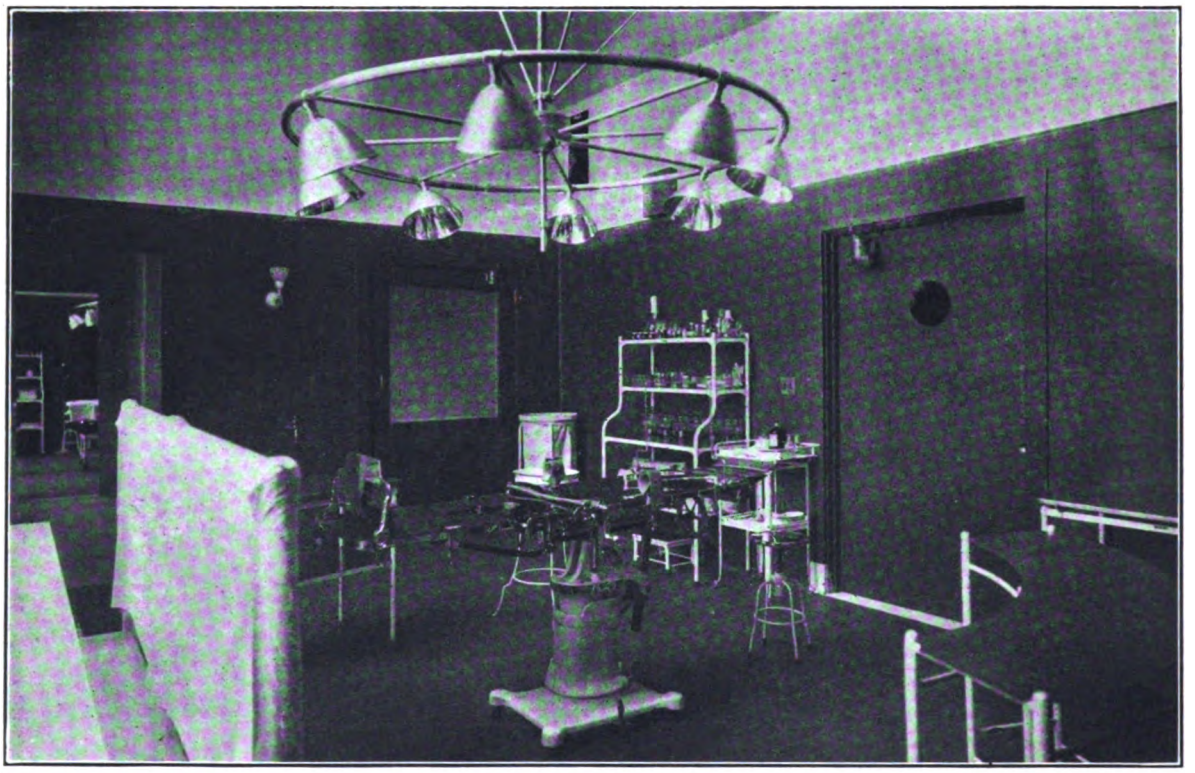

FIG. 8.—OPERATING ROOM

trating the use of plaster-of-Paris and other orthopedic appliances.

Surgery 7 is the surgical clerkship required of the fourth-year men during one trimester. The students are assigned patients in the wards. and are required to record histories, make physical examinations, perform routine laboratory examinations, and follow their patients to operation where they may assist. Ward rounds are conducted for them, and they are held responsible by the instructor for an understanding of their cases from admission until discharge. At present 552 hours are required in general surgery. Several elective courses are offered in surgical technique, cystoscopy, oral surgery, anesthesia, surgical anatomy, and surgical pathology, in which an attempt is made to stimulate the student to independent work without detailed instruction from the teacher.

The hospital is an integral part of the medical school and the hospital interne year is a part of the regular course required for graduation. The wards are closely connected with other departments of the college, and patients occupying beds not only afford material for the clinical teachers, but are freely utilized by instructors in preclinical subjects. In all of the teaching of the Department of Surgery constant effort is made to review the fundamental sciences with the students, and to correlate the instruction of the clinical and preclinical years.

The staff of the Department is not only responsible for the clinical care of the large number of public-ward patients, but renders surgical attention to the staff of the College and to a large and growing private patient service. This heavy responsibility falls on a very few men of the senior staff who, like all other teachers in the College, are on a full-time academic basis. All fees from private patients are paid to the institution, and there has arisen not the slightest difficulty of any kind on this score. The clinical men are paid the same salaries as their colleagues in the non-clinical subjects, and there has been no dearth of men for the places to be filled.

SUBJECTS OF RESEARCH

The Department of Surgery has laboratories equipped for research in bacteriology, pathology, and surgical technique. An effective "follow up" system has been instituted, and an increasingly

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FIG. 9.—MALE SURGICAL WARD

complete record of end results is on file and is being used for clinical research.

Dr. J. Heng Liu is studying transplantable tumors in small laboratory animals, and personally studies all neoplastic tissue from the clinic or sent in for diagnosis from the outside.

Dr. F. L. Meleney is studying the biological reactions of *Streptococcus hemolyticus* and has recently published an extensive study of cases of gangrene caused by this organism. With Dr. Gavin Miller he has just completed a study of gangrene due to *thrombo-angiitis obliterans* in the Chinese. Dr. Z. D. Zau and Dr. Meleney have studied suspension media for streptococci and the bactericidal and toxic action upon animals of acriflavine injected intravenously.

Dr. Char is studying the methods of local block anesthesia, especially sacral anesthesia as applied to pelvic and perineal surgery.

Dr. Webster has just completed an extensive study of aseptic anastomosis of the intestine and has ready for publication results following methods devised by him.

Dr. Van Gorder, who has been on furlough during 1923-1924, is interested in devising orthopedic appliances suitable for the local needs of the clinic and has trained wood, metal, and leather workers so that satisfactory prosthetic apparatus is being made in our own shop, at a small fraction of the cost of imported articles.

STAFF

Adrian S. Taylor, M.D., F.A.C.S., professor of surgery and head of the Department

J. Heng Liu, S.B., M.D., associate professor of surgery

Frank L. Meleney[1], A.B., M.D., associate professor of surgery

George W. Van Gorder, A.B., M.D., associate in surgery

George Y. Char, S.B., M.D., associate in surgery

Bert G. Anderson, D.D.S., associate in oral surgery

Zung-Dau Zau, M.D., associate in surgery

Harold H. Loucks, A.B., M.D., assistant in surgery

Jee Lum Wong[2], D.D.S., assistant in oral surgery

T. C. Yang, M.D., assistant in surgery

---

[1] Resigned January 1, 1925.

[2] Resigned March 1, 1925.

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C. M. Oman, M.D., F.A.C.S., Commander U. S. N., hon. lecturer in surgery.

Besides the professional staff there are in the Department the following: Secretary, typist, four technicians, two mechanics.

EXPENDITURE (ESTIMATED), 1923-1924

Salaries for professional staff	Mex. $51,100
Supplies and replacements	2,000
Total	Mex. $53,000

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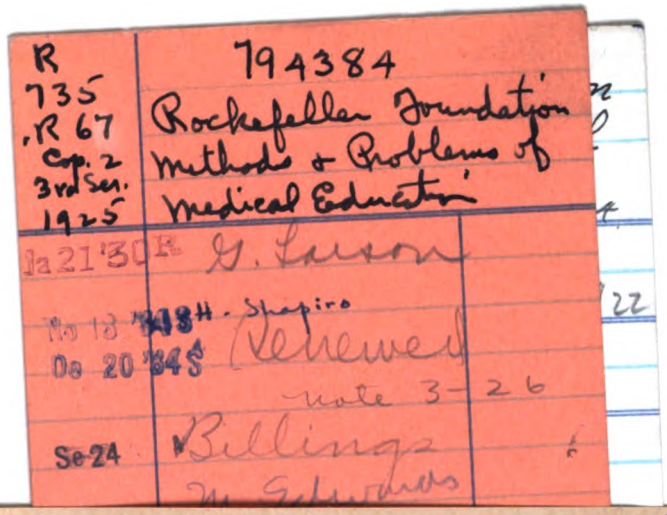

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